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Condensers to Reduce Line Current. THE interesting paper by Dr. Bedell and others, read at the last meeting of the American Institute of Electrical Engineers, and of which we publish an extract elsewhere, seems to reopen the question of closed versus open circuit transformers, which was thought to have been definitely decided in favor of the former. The method of using condensers to reduce the line current, however, is scarcely a new idea, and has been, we believe, covered by patents as applied to transformers used in connection with the Stanley-Kelly two-phase system. Their use for this purpose is described in THE ELECTRICAL WORLD, of April 29, 1893, where a curve is given showing the large reduction thus made. In a specific case where the true watts were 498, the volt-amperes were 900 with, and 2,800 without, condensers.

Storage Battery Traction. WE give elsewhere an account of the Waddell-Entz storage battery traction system now in use on the Second avenue street railway, in New York, and through the courtesy of Mr. Justus Entz, to whom the practical success of the system is largely due, we are enabled to add detailed figures giving the cost of operation. We do not know of any other similar case in which all of the engineering details have been as carefully worked out as in the present one, nor of one in which such a systematic account has been kept of all of the commercial factors concerned in the actual working of the plant. The figures presented are not only encouraging, but exceedingly favorable in comparison with competing systems of street railway traction. This is gratifying in view of the great field open to storage battery traction, which has advantages possessed by no other system and is indeed the ideal system. That those interested financially in the success of the trial are satisfied with the results is manifest from the announcement made that storage battery cars are to be introduced on the southern section of the road.

Differential Charges for Electric Current. IN this issue we publish the conclusion of Mr. Otto Frick's interesting article on a new method of charging for electric current from central stations. We doubt if the agreement proposed would meet with the approbation of customers, and it presents practical difficulties in metering. We believe that some central stations in Europe make a reduction in price for current used during the day time, the day circuit being on a separate meter. In our issue of May 27, 1893, we described and illustrated a differential meter invented by Mr. Gisbert Kapp to perform the operations now requiring two meters in these cases, but which could be modified in a simple manner to admit not only of several different charges during a day, its action being automatic in this respect, but also of being quickly adjusted so as to admit of different rates at different times of the year. It is probable that in order to encourage the use of electric power the practice of charging a smaller day rate will become more general, but there seems to be little more prospect at present of extending such a differential system in electric distribution than there is in our adopting the European differential rate system on our street railways.

The End of the World's Fair. THE farewell exercises attending the closing of the World's Fair took place on Monday, and one of the finest achievements of the American mind and brawn has now become a thing of the past. Its memory, however, will always be fondly cherished, not only by all Americans through patriotic pride in its success, but by the thousands of foreigners, of whom some came to scoff, but all departed with a profound sense of admiration for a people whose genius they were thus enabled to comprehend. The W. J. Johnston Company was the first firm in New York that contributed to the Chicago World's Fair fund, and the interest thus early shown by THE ELECTRICAL WORLD in the success of the undertaking did not afterward relax, as our readers can bear abundant testimony. No other technical journal devoted so much attention or spent so much money in illustrating and describing the exhibits at the World's Fair. From a purely commercial standpoint the great expense incurred in elaborately presenting through our pages the electrical features of the Fair may not have been justified, but the only object kept in view was to freely give the space and setting appropriate to a matter that so deeply concerned national pride. Now that the beautiful White City is to be leveled to the earth and its electrical marvels dispersed, we feel a regret, which, however, is lightened by the knowledge that, while the substance may thus disappear, the effect on the minds of men will continue to exist and bear fruit.

The Niagara Plant. AFTER perhaps the most carefully considered competition in the annals of engineering, the Niagara Falls Power Company has awarded to the Westinghouse company a contract for two-phase generators, thus committing itself to the two-phase system. This termination was foreshadowed by Prof. Forbes' remarks in the discussion on alternating current systems in Section C of the Electrical Congress at Chicago, given in THE ELECTRICAL WORLD of Sept. 9, in which he gave at some length reasons which doubtless were the same ones that influenced the technical commission in their decision. A most surprising feature is the low frequency adopted, even for power purposes, and it is said that current for lighting will also be used from the same low frequency circuits, although we have been unable to obtain a confirmation of this. Heretofore 40 periods per second have generally been accepted as the limit for lighting purposes on account of the supposed flickering of lamps that would occur with a lower number, and at the Chicago discussion Dr. Bell gave the practical limit for lighting at from 30 to 35 periods, while Dr. Duncan said nothing below 50 periods should be used. Prof. Rowland also referred to very low frequencies as a disadvantage on account of the large transformers required, the less output from a given dynamo and the necessity of a close balance between the two sides of the circuit. We may feel assured, however, that all of these and other points relating to the frequency were most maturely considered before the decision was arrived at. Now that the award has been made, we trust that the officers of the company will not continue their policy of denying all technical information to the public, which is so deeply interested in the great work being done at Niagara.

Electric Cooking. THE subject of the cost and efficiency of electric cooking and its comparison with the ordinary coal stove cooking has recently been discussed so much that it is becoming tiresome, since the results, as far as they refer to the difference in cost and efficiency of the two systems, are not at all satisfactory. Some authors base their calculations on such things as the specific heat of a mutton chop or a roast, while others base them on the loss of weight of the victuals, crediting the difference to the evaporation of the water, and assuming this to correspond to the calories consumed, all of which may be interesting; but it is of no use, other than to give an opportunity to advertise so-and-so's new electric stove. Why does not some practical person settle the question once for all by making an experiment somewhat as follows: Let him take two stoves of equal cooking capacity, one electrical and the other an ordinary cooking stove, and let each be used for one day of 24 hours for cooking three meals, using the same quality and quantity of the materials to be cooked in each stove, and let the results be recorded, the coal being carefully weighed and the electricity being measured in a meter. If the heating of the dishwater is so much more costly with an electric stove, as is claimed in an article abstracted in this week's Digest, then let the electric stove be provided with a coal heater for heating the water. But it will be very necessary in this case, in order to make it a true practical test, to let the coal stove be run by an ordinary intelligence office cook, as any one who has had experience will know what a difference there is in the coal bill when an intelligent person does the cooking than when it is done by a servant of the ordinary quality who has no interest in the coal bill and no mercy. To be fair, however, such a result must be accompanied by an enumeration of the indirect advantages in using an electric stove, which advantages are probably of much more importance than a few cents more or less in the actual cost of the source of energy. Light from an oil lamp is very much cheaper than the same amount of light from incandescent lamps if the current is taken from central stations, yet incandescent lamps are used in preference, in thousands of cases.

Candle Power of Incandescent Lamps. THE variation of the candle power of incandescent lamps with different currents or E. M. F's. was early made a subject of investigation, but none of the formulæ thus far can be said to give entirely satisfactory results, at least for a wide range of candle power. Of the earlier investigators Dr. Higgs stated that the candle power varied as the fourth power of the current or as the square of the watts. Dr. Hagen gave these powers as five and three respectively, while Mr. Preece found the former to be six. In a paper in *Van Nostrand's Engineering Magazine* of March, 1885, on "Incandescent Lamp Economy," an analysis of numerous experiments showed that they could be closely represented by an equation in which the candle power was a function of the watts raised to the 2 85th power, and that an equation of the same form but involving current instead of watts was not satisfactory on account of much greater variation of the exponent as calculated. In the same paper it was pointed out how the greatest economy in the use of incandescent lamps could be determined—a subject afterward considered in England by Prof. Ayrton—and it is in this connection that the form of the equation representing the variation of the candle power with the energy or E. M. F. assumes a practical importance. In another column Mr. Albert G. Davis proposes a formula which differs somewhat from the usual one in that the candle power is assumed an exponential function, not of the entire watts at normal candle power, but of the normal watts minus the number of watts which will just keep the lamp a dull red. That this may be nearer the truth seems reasonable, as it takes into consideration the fact that the energy of an incandescent lamp is partly dissipated in rays of wave lengths too long to give the effect of light; the assumption, however, that the number of watts to be subtracted is constant and equal to what will just keep the lamp a dull red is a purely arbitrary one which requires more confirmation than the few data used can give. For practical purposes it is only necessary to determine the effect of changes for short ranges on each side of the normal voltage, so that the fact that an equation is not true at very small or very large candle power has little interest practically. What is wanted is a formula that will express as exactly as possible the effect of changes from the normal incandescence due to changes of voltage of not over, say, 10 or 15 per cent. It is very probable that the more simple exponential equation will express this sufficiently close for any practical purpose, but, nevertheless, one based on more rational principles is not without interest.

The Niagara Electric Plant.

After protracted and exhaustive examination of many plans submitted by various electrical companies in America and Europe, the Niagara Falls Power Company announces that it has awarded to the Westinghouse Company, of Pittsburgh, Pa., a contract covering the construction and installation of three alternating current dynamos of 5,000 h. p. each, after designs originating with the engineers of the Cataract Construction Company, and especially adapted to the particular requirements of the hydraulic installation of the Niagara Falls Power Company. The system adopted involves the use of two-phase current, with a frequency of 25 periods per second, generated at a voltage of 2,000, and the use of transformers for long distance transmission at higher tension.

The officers of the Cataract Construction Company include the following well known business men: Edward D. Adams, who is president; Francis L. Stetson, Edward A. Wickes, Wm. B. Rankin, and Dr. Coleman Sellers as engineer, with Prof. George Forbes, of London, as consulting engineer. These gentlemen have devoted a great amount of time and study to the investigation of the requirements of their plant during the past two years, and they have also had as consulting engineers many of the best known electricians of the world.

The Cataract Construction Company has been conducting negotiations with the principal electric manufacturing companies, including the Westinghouse Electric and Manufacturing Company, the Siemens & Halske Company and the General Electric Company. Early in the spring of the present year bids were received based upon specifications advocated by the individual companies, in which the different companies were at liberty to advocate the different systems and class of machines which they preferred. The system finally adopted was the two-phase alternating current, Tesla system. After a careful study of the conditions under which the apparatus had to operate the engineers of the Cataract Construction Company prepared a complete set of specifications calling for the employment of the two-phase system, new proposals were submitted, and the contract was awarded to the Westinghouse Electric and Manufacturing Company, as above stated.

The apparatus will be built in units of 5,000 h. p. The revolving field of the generator will be constructed with inwardly projecting poles, and will revolve in a horizontal plane, being mounted upon the vertical shaft of the turbine

The weight of the shaft, turbines and armature is to be carried by the upward pressure of the water columns producing the heads for the turbines. The electromotive force generated will be 2,000 to 2,400 volts, and will be increased by step-up transformers for long distance transmission, and lowered by reducing transformers for distribution. The motors will be the two-phase Tesla motors, which have been found to be well adapted for power purposes, although this question is not definitely settled. The system adapts itself readily to the use of motor generators or rotary transformers, so that it is possible to develop either single-phase alternating currents or continuous currents of any desired electromotive force, as may be required for the use of individual customers. It is expected that a large amount of power will be employed for manufacturing purposes, arc and incandescent lighting, electrolytic work and power purposes generally. It is also understood that the company contemplates sending current at high electromotive forces to Buffalo and greater distances, to be used for lighting and power purposes. The work upon the apparatus has already been begun, and it will be installed at the earliest possible date.

Candle Power of Search Lights

BY CARL HERING.

In the last week's issue of The Electrical World Mr. Steinmetz criticises a statement made in the previous week's "Digest" regarding the candle power of search lights. If his criticisms refer to the first portion of that paragraph, I will leave it to the author of the original statement to reply. But if, as it appears, they refer to the compiler's parenthetical remarks, I desire to say a few words in reply, as Mr. Steinmetz has greatly misrepresented my statements, though he may have done so unintentionally. My comments do not say, or even imply, that the rule which he gives for the calculation of such lights (which is practically the same as the one I gave) "is an absurd assumption"; on the contrary, I said "that it may be approximately correct," and by approximately I meant, of course, that it does not take into account the loss in the mirror and lens, as also other small losses. Neither did I make the "mistake" of assuming the rays to be parallel, as I distinctly stated, in qualifying my remarks, that they are not parallel, but only "nearly parallel," which makes a very great difference, as all the loss there is, besides absorption and dispersion, is that due to the small angle of the rays.

In using the photometer, however, it would be incorrect to apply the inverse square law in the usual way, for in that case the rays may be considered practically parallel, they are at least by far more nearly parallel than they are divergent from the search light considered as a source, and therefore I stated that, to thus apply the inverse square law "is absurd *unless qualified*." which I illustrated by an example which, I am sure. Mr. Steinmetz will admit shows the absurdity of applying the law unqualified, a mistake many are apt to make and do make.

To illustrate more fully what was meant by this "qualification," which space did not permit my going into in detail in that brief note, let S in the adjoining figure be the search light, and let the rays diverge, say, about two degrees. To apply the law of inverse

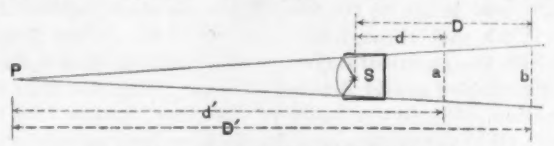


Diagram of Search Light Rays.

squares unqualified would lead to the manifestly absurd result that the intensity at a was four times that at b, if D is equal to twice d. This mistake is the one which I wanted to warn readers against making, and I venture to say that no one who has looked into the matter will claim that this is not a mistake. If one wishes to apply that law it would be necessary to find the point P where the rays would meet if continued; that is, the theoretical origin of the light if it is supposed to emanate from a point. The law can then be applied, if the distance d' and D are used in the calculation. But although this would be theoretically correct, provided the beam really was constituted as if issuing from a point (which it is not), I do not think such a calculation would be of much value by itself, as the absorption and dispersion in the atmosphere, the difficulty of determining the distance of the imaginary point P with any degree of accuracy, and the fact that the beam is not of equal intensity throughout its cross-section—all three introduce errors, if they may be called errors, which probably would affect the result so much that they are of equal, if not of greater importance in the calculation than the law of the inverse squares. If Mr. Steinmetz can describe how calculations of the candle power of search lights from photometric measurements are made in practice by those well up in the subject, the matter would, doubtless, be of great interest to many; I have inquired of the United States Naval Department, as also of several of the most prominent makers of search lights in Europe, but without obtaining any satisfactory replies.

The Proposed Antwerp-Brussels High Speed Electric Road.

We have recently received a pamphlet containing a large number of newspaper comments and interviews regarding this proposed road, some of which contain quite interesting matter. The pamphlet, however, does not include a detailed description of the road other than a map showing the course, which is made up almost entirely of two straight parts, the cover containing an illustration of the outside and inside of the proposed car. The project is that of Mr. P. Van den Kerchove. A short description of this road was given in The Electrical World, Sept. 16; in addition, the following, taken from this pamphlet, may be of interest: "There is to be only one, or possibly two, cars to a train, and they are to carry 60 people; the cars are to be made like the Pullman cars in this country, and the motors are to be placed on the cars themselves; the line for the current is to be overhead."

Moonlight Tables for December, 1893.

Herewith we give Mr. H. W. Frund's tables of lighting hours for the month of December under his modified form of moonlight schedule.

TABLE NO. 1. Standard Moonlight. Philadelphia System.				TABLE NO. 2. Frund's New Moonlight System.			
Date.	Light.	Date.	Exting.	Date.	Light.	Date.	Exting.
1	5:00 P. M.	2	2:30 A. M.	1	5:00 P. M.	2	2:30 A.M.
2	5:00	3	3:30	2	5:00	3	3:30
3	5:00	4	4:30	3	5:00	4	4:30
4	5:00	5	5:40	4	5:00	5	5:40
5	5:00	6	6:10	5	5:00	6	6:10
6	5:00	7	6:10	6	5:00	7	6:10
7	5:00	8	6:10	7	5:00	8	6:10
8	5:00	9	6:10	8	5:00	9	6:10
9	5:00	10	6:10	9	5:00	10	6:10
10	5:00	11	6:10	10	5:00	11	6:10
11	5:00	12	6:10	11	5:00	12	6:10
12	5:00	13	6:10	12	5:00	13	6:10
13	8:30	14	6:10	13	5:00	14	6:10
14	9:30	15	6:10	14	5:00	15	6:10
15	10:30	16	6:20	15	5:00	16	6:10
16	11:30	17	6:20	16	5:00	17	6:10
17	.....	..	.....	17	5:00	17	12:00 M.
18	12:50 A. M.	18	6:20	18	12:50 A. M.	18	6:20 A.M.
19	2:00	19	6:20	18	5:10 P. M.	18	12:00 M.
20	3:20	20	6:20	19	2:00 A. M.	19	6:20 A.M.
21	4:20	21	6:20	19	5:10 P. M.	19	12:00 M.
22	No light	22	No light	20	5:10	20	12:00
23	No light	23	No light	21	5:10	21	12:00
24	5:10 P. M.	24	7:20 P. M.	22	5:10	22	12:00
25	5:10	25	8:40	23	5:10	23	12:00
26	5:10	26	10:00	24	5:10	24	12:00
27	5:10	27	11:10	25	5:10	25	12:00
28	5:10	29	12:20 A.M.	26	5:10	26	12:00
29	5:10	30	1:20	27	5:10	27	12:00
30	5:10	31	2:30	28	5:10	29	12:20 A.M.
31	5:10	1	3:30	29	5:10	30	1:20
				30	5:10	31	2:30
				31	5:10	1	3:30

Storage Batteries in Commercial Work.

BY J. ARNOLD.

Mr. C. O. Mailloux's interesting paper, an abstract of which appears in The Electrical World of Oct. 28, touches on a subject which will demand the serious attention of American electrical engineers in the immediate future.

Storage batteries have been neglected because their advantages have not been fully understood and their faults exaggerated, and electrical engineers have looked upon them as things to be avoided, or, to put it in the words of an advocate of alternating currents: "One great advantage of the alternating current system is, that you can't put storage batteries on the circuits."

In Europe storage batteries have received the attention they deserve, and on all sides testimony comes from users that, in cases where they are judiciously introduced, the result is eminently satisfactory.

Until quite recently enough attention has not been paid to designing the cells to suit the special conditions under which they have to work. Engines and dynamos are carefully designed according to the work they have to perform, and engineers know well the loss in efficiency and economy that occurs through employing unsuitable machinery.

The question of design or construction of storage batteries affects the cost of maintenance much more than is generally understood, and this question of maintenance is always the first to be discussed when storage batteries are considered.

It is not difficult to design a cell which, when properly erected and started, will not require a larger amount per centum set aside for maintenance than the other portion of an electric light or power plant.

When the action which governs the practical working of a storage battery is understood, it is surprising how simple is the attention necessary to maintain it in an efficient condition, provided the attention is given methodically.

In some forms of cells which are used in Europe even now for heavy work, it is very difficult, if not impossible, to maintain them cheaply, as the construction is such that an enormous amount of labor, and sometimes material as well, is necessary to keep them in good working order.

The latest design of cells of the Crompton-Howell, Tudor, Electrical Power Storage and Epstein types show great improvement in the way of rapid discharge, and it is probable that still further advancement will be made in this direction, and this will greatly increase the use of storage batteries, as in many cases where they would be used for rapid discharge the price of cells large enough to give the required discharge is prohibitive, and the capacity many times greater than is needed.

Now that it is possible to form plates of the Plante type in a much shorter time, taking hours where it used to be days, and to obtain a greater degree of porosity in the plates, undoubtedly this form of cell will be largely used where high rates of charge and discharge are required, although the makers of the pasted plates have modified the grids to enable them to cope with these conditions, and have met with great success.

Of course, for ordinary work, such as lighting country houses, etc., the motive power being gas, oil or water motors, the cells are not subjected to such a severe strain as in light and power stations, and the writer is acquainted with many such installations, ranging from 25 to 200 lamps, where the whole plant is successfully run by a gardener or laborer, who after a week or two of training is quite able to run the installation intelligently from his instructions.

This class of installation is comparatively unknown in this country, while in Europe, and especially in England, they are met with in all parts.

Let it be realized how easily and cheaply this kind of installation, with all its advantages and comforts, can be fixed and worked, and there will be opened up a large field of profitable work.

Among the many applications of electric lighting by means of storage batteries none will prove more successful and popular than train lighting. The conditions of the train service in this country are much more favorable to the use of electric light than in Europe, and, giving a properly designed accumulator, with a suitable system of lighting, the advantages to the passengers of railroad and other companies would be enormous. In this country, where railroad traveling has approached nearer perfection than anywhere in Europe, it seems strange that the companies do not adopt this great improvement, which has been tried and found successful on some less perfectly equipped lines.

It should not be a difficult matter to convince a board of directors that train lighting by electricity can be done cheaply and with advantage to them and their passengers, and probably we shall very soon see an advance in this direction.

The opportunities which await storage battery manufacturers are many and profitable, if they will only endeavor to study the different requirements of the

various uses for which accumulators are wanted, and show their customers that only ordinary attention and care are required to maintain them.

On the Candle Power of Incandescent Lamps.

BY ALBERT G. DAVIS.

The ordinary empirical formula c. p. $= a\ W^b$, used to represent the relation between the candle power and energy consumed in incandescant lamps, does not give results accurate nearly within the error limit of the observations. One reason that suggests itself for the discrepancy is as follows: The curve of candle power and watts does not begin at the origin, but rises from a fairly large positive value of W, and the formula mentioned tries to fit an exponential curve through the origin on to an observation curve rising some distance to the right. This trouble will appear more strikingly if we take logarithms of both sides of the equation c. p. $= a\ W^b$. We have,

$$\log \text{c. p.} = b \log W + \log a,$$

the equation of a straight line. Therefore, if we plot logs of candle power and of W, the points should fall on a straight line, and the manner in which they do so is a test of the manner in which the equation represents the observations. But $\log 0 = -\infty$, and the curve goes to negative infinity for that value of W for which the lamp gives no light.

In choosing a form for an empirical formula we should as far as is possible and convenient approach the form of the unknown law. When the lamp is heated by the current it begins at once to give off radiant energy, and subtracting the loss by conduction the lamp as a converter of electrical into radiant energy is perfectly efficient. But if that energy is given off at a low temperature its wave length is too long to affect the eye. It must also be remembered that the first light given off, as the voltage is raised, is red, and that it is only when the shortest wave reach a length corresponding to some point in the spectrum near the yellow that the lamp begins to give useful light. Therefore, for an empirical formula it is proposed to assume that the candle power is an exponential function of the activity $E\,C$ minus that number of watts which will just keep the lamp at a dull red. The formula then takes this form :

$$\text{c. p.} = a(W - c)^b,$$

where c is the minimum number of watts for a dull red, as just mentioned, and a and b are constants to be determined experimentally for each lamp or set of lamps.

If we now take logs of both sides, we have

$$\log \text{c. p.} = b \log (W - c) + \log a,$$

which gives a curve capable of rising at any point on the axis of X.

In the January, 1893, issue of the *Bulletin de l'Association des Ingénieurs Electriciens sortis de l'Institut Electrotechnique Montefiore*, Messrs. Feldmann and Nagtglas-Versteeg give an account of their work on this subject. They assumed c. p. $= a\ W^3$, and give curves and tables from their experiments. A lamp, a 110-volt 16 c. p. Khotinsky, was placed on a circuit whose voltage was varied from 52 to 176. A table is given of volts, watts, ampères, candle power observed, candle power calculated by two different empirical *formulæ*, watts per candle power observed and calculated, and resistance of lamp at 32 points.

It was decided to apply the formula developed above to this set of experiments. As the writers claim that the very high and very low values of the candle power are inexact owing to the screen approaching so close to the lamps, and as the action of a 16-c. p. lamp giving some hundreds of candle power seems to be of little practical or theoretical interest, the points above 113 watts, 88 c. p., were disregarded. The observations appear to be concordant up to this point, with the exception of No. 23, which falls so far from the others that it evidently contains a mistake, and would be rejected by any of the ordinary *criteria*.

The points were plotted, candle power against watts, and the "best representative curve" drawn. Such a curve represents the performance of the lamp better than the observations themselves. The value of the constant c was taken at 17. This is a matter of judgment, and a watt more or less does not appear to make much difference. At 17 watts the lamp gave about 0.1 candle power. At $W = 27$, 37, etc., up to 107 and 113 the values of candle power were read off from this curve. This process of course eliminates to a great extent the accidental deviations of observation.

Plots were then made with log candle power as ordinates and log W and log $(W - 17)$ as abscissas. It was found that the points corresponding to log W did not lie well on any straight line, and for low values of W the curve turned off toward parallelism with the axis of X; while the second set of points fell very near to the line

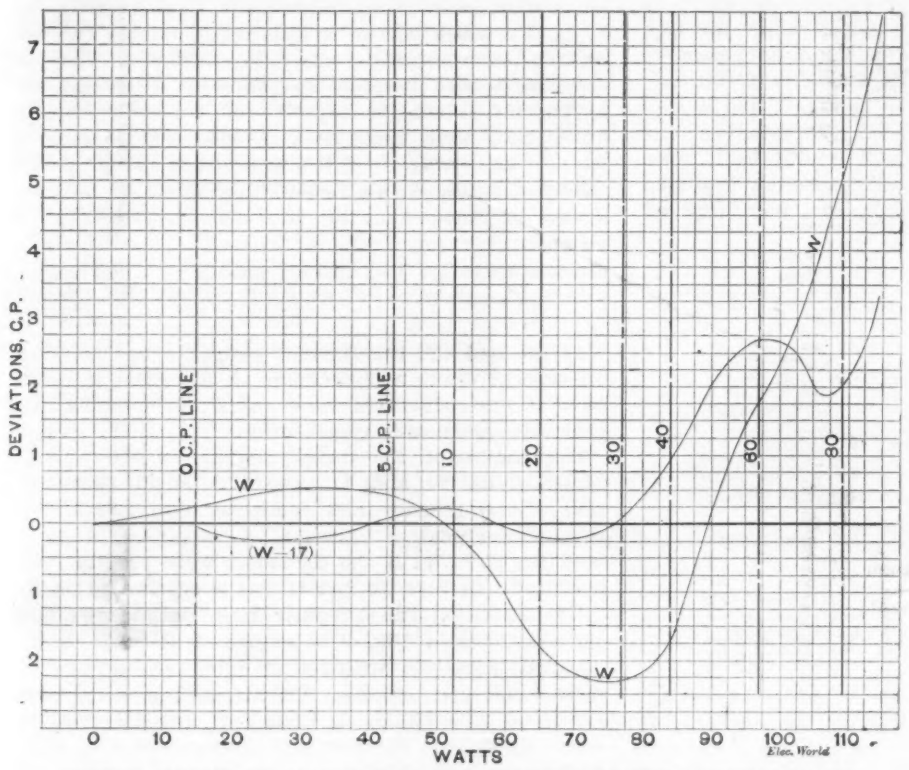
$$y = 2.225\ x - 2.446, \text{ or}$$
$$\log \text{c. p.} = 2.225 \log (W - 17) - 2.446.$$

Operating on each side with $\log^{-1}$, we have

$$\text{c. p.} = 3.58 \times 10^{-3} (W - 17)^{2.225},$$

the equation sought.

The curve corresponding to this was plotted on the same sheet with the experimental curve, as was also that corresponding to the best law deduced by the original experimenters, c. p. $= 6.56\ 10^{-5}\ W^3$. The lines ran so closely together that a reproduction of the plot would be of small value unless on a large scale, but the figure shows a residual plot showing the differences between the ordinates, or the deviations, of each of the two empirical curves from the experimental curve. It will be seen that the $(W - 17)$ formula has a maximum error of 0.2 c. p. up to $W = 77$, c. p. $= 30$, and that the corresponding maximum of the formula of the experimenters is 2.4 c. p. While the former amount is negligible in calculations of rheostats for theatres, variation with change of voltage, economy of different voltages, etc., the latter would probably not be.



CURVE SHOWING VARIATION OF CANDLE POWER WITH WATTS.

Above 112 watts both formulæ depart more widely from the experimental curve, and at $W = 128$ the error of the $(W - 17)$ law becomes the greater. At the same point a rapid fall of resistance sets in, and it seems probable that some new actions are taking place. At $W = 183$ the $(W - 17)$ curve again comes nearer the experimental. For all these points the candle power values given are probably very inexact, as they do not lie well on any smooth curve.

The formula for watts per candle power corresponding to the form proposed is, of course,

$$P = AW(W - c)^{-b},$$

where A, a constant, is the reciprocal of a above.

This method is proposed for obtaining a simple and fairly accurate working formula, for cases where the ordinary one is too inexact.

Hedgehog Transformer and Condensers.*

BY FREDERICK BEDELL, K. B. MILLER AND G. F. WAGNER.

After giving a historical account of the use of the method of instantaneous contact in the investigation of alternating currents, the authors describe their modification, which is illustrated in Fig. 1. The whole instrument is supported by a stationary frame F. The shaft, S, is connected to the armature shaft of the dynamo by a coupling (not shown) and carries the disc D, which revolves with it. The needle N projects from this disc and forms one of the electrodes of the contact. The other electrode is a fine water jet (not shown) issuing from the nozzle J, well insulated by hard rubber from the rest of the instrument. The fine jet is maintained from a jar of water, several feet above, to which it is connected by a flexible rubber tube. Electrical connection is maintained with the water jet by a wire which passes through this tube and is soldered to the nozzle J. Electrical connection with the needle point electrode is obtained through the shaft and frame of the instrument. The needle cuts the water jet once in every revolution of the armature of the dynamo and makes a contact which is well defined and unvarying. The nozzle of the water jet is carried

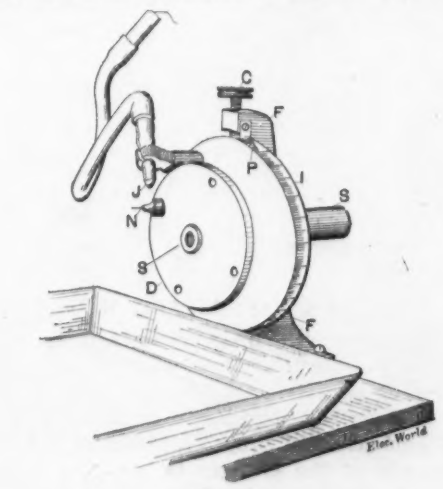


FIG. 1.

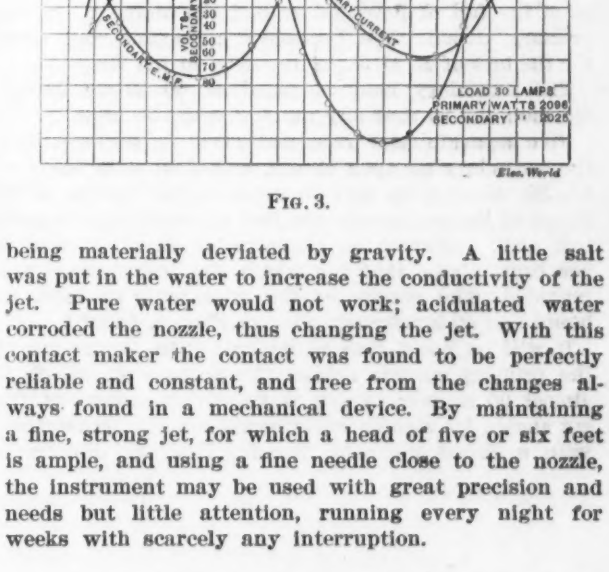


FIG. 2.

upon an index disc I, which can be turned into any position by revolving it upon a projecting collar of the frame, which forms its bearing. The water jet is held in any position by securing the index disc by means of the set screw C in the top of the frame. Its position is indicated by the pointer P, upon the scale on the circumference of the index disc, which is graduated in degrees.

The needle cuts the water jet very near the nozzle at a point where the jet is quite stiff, due to the head of water. The nozzle is radial, and the jet keeps the direction of the nozzle for some little distance before being materially deviated by gravity. A little salt was put in the water to increase the conductivity of the jet. Pure water would not work; acidulated water corroded the nozzle, thus changing the jet. With this contact maker the contact was found to be perfectly reliable and constant, and free from the changes always found in a mechanical device. By maintaining a fine, strong jet, for which a head of five or six feet is ample, and using a fine needle close to the nozzle, the instrument may be used with great precision and needs but little attention, running every night for weeks with scarcely any interruption.

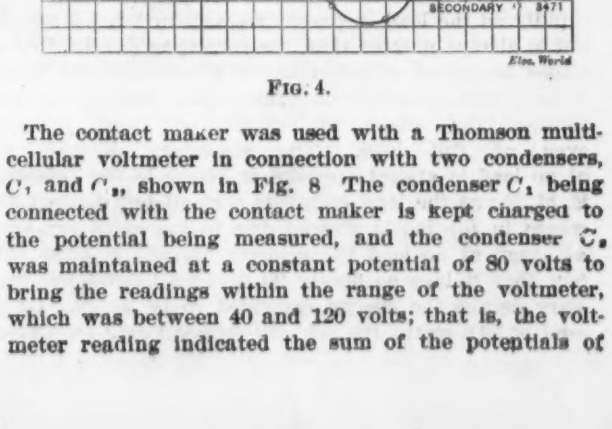


FIG. 3.

FIG. 4.

The contact maker was used with a Thomson multicellular voltmeter in connection with two condensers, C_1 and C_2, shown in Fig. 8 The condenser C_1 being connected with the contact maker is kept charged to the potential being measured, and the condenser C_2 was maintained at a constant potential of 80 volts to bring the readings within the range of the voltmeter, which was between 40 and 120 volts; that is, the voltmeter reading indicated the sum of the potentials of

*Abstract of a paper read at the eightieth meeting of the American Institute of Electrical Engineers, Oct. 18, 1893.

the two condensers C_1 and C_2, so that, for example, a reading of 85 volts indicated five volts difference of potential. For a P. D. beyond 120 volts, the instrument was connected between two points of a non-inductive resistance, and the measurements of currents were made by determining the drop in potential along a known non-inductive resistance.

The transformer upon which these experiments were made is a 60-light hedgehog transformer, built on the general lines of an old-fashioned induction coil. A thin casting of gun metal, cross shaped in section, runs through its centre and supports the flanges of the spool. The four angles of this casting are filled with soft iron wires, running lengthwise, thus forming a cylindrical core. These wires are considerably longer than the castings and are spread out at their free ends, thus making a partial return for the magnetic lines. Half the secondary turns are first wound around this core, then all the primary, and finally the other half of the secondary. The primary consists of 1,426 turns of wire 0.072 inch in diameter, arranged in 12 layers. It has a resistance of 2.748 ohms and weighs 29 pounds. The secondary consists of 73 turns of 19 ÷ 0.058 cable, in two layers. Its resistance is .0149 ohm, and weight 12.5 pounds. The transformer is designed for a primary potential of 1,000 volts, with a frequency of 130.

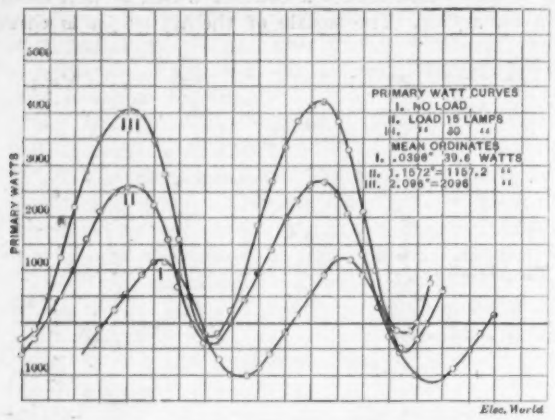
This transformer was supplied with current from a Westinghouse alternator with a frequency of 133. The potential was kept constant at 1,154 volts by varying the exciting current. The connections were as shown in Fig. 8 in full lines. The primary E. M. F. was measured by measuring the fall of potential around a portion of the non-inductive resistance R_1 of incandescent lamps, and the secondary E. M. F. similarly found by measuring the fall of potential around one of the three lamps, R_2, placed in series across the secondary terminals. The primary current was found from the fall of potential around the lamps R_3 in the primary circuit. The necessary correction was made for the loss of E. M. F. by the drop in the lamps R_3.

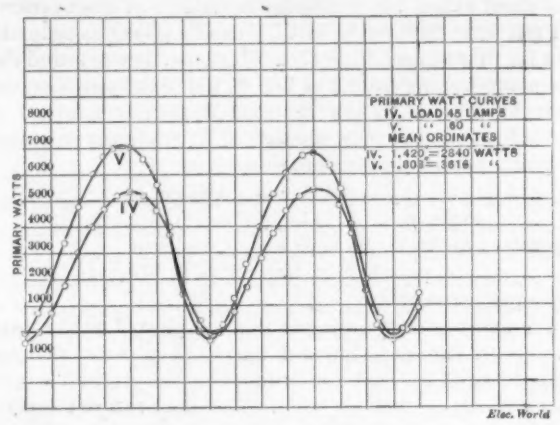
The secondary load consisted of 60 50-volt lamps, R_4, mounted so that any number could be used.

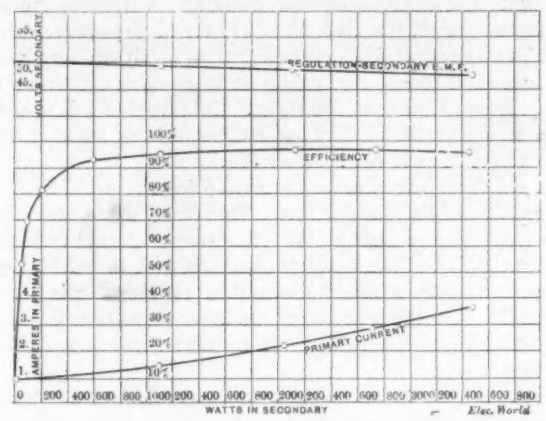
Five separate runs were made, first for no load, with the secondary on open circuit, and then with loads of 15, 30, 45 and 60 50-volt incandescent lamps. With lamps of this resistance the last run was quite beyond full load, inasmuch as the primary E. M. F. was 15 per cent. above that for which the transformer was intended. The results of the runs with no load, 30 lamps and 60 lamps, are given in Figs. 3, 4 and 5.

It will be noted that at no load (Fig. 3) the lag of the primary current behind the primary E. M. F. is almost 90 degrees, which is greatly in excess of the lag shown by similar experiments upon a transformer with a closed magnetic circuit. This lag diminishes rapidly as the load increases, as seen in Figs. 4 and 5, but is always greater than the corresponding load of a closed magnetic transformer, on account of the large magnetizing current in the open circuit transformer, the effect of which is quite marked even at full load. The secondary E. M. F. at no load is almost opposite in phase to the primary E. M. F.; as the load increases a small but distinct increase in the lag is noticed due to increased leakage. Although at no load the primary current is large the fact that it lags so nearly 90 degrees behind the primary causes the energy expended to be small. Of a total of 39.6 watts, the primary copper losses amounted to 2.578 watts, leaving 37.02 for the core losses—hysteresis and eddy currents. Primary watt-curves are shown in Figs. 5 and 6.

In any transformer, if the primary E. M. F. is a sine curve the current curve would also be one in case there were no hysteresis or eddy currents. In the no load diagram in this transformer the primary current curve is not materially different from a sine curve 90 degrees behind the E. M. F., while in the no load diagrams of closed magnetic circuit transformers supplied from this same alternator the curves for the primary current depart widely from the sine curves, and are much nearer the primary E. M. F. in phase. Thus the form and position of the current curve in the open magnetic circuit transformers show the hysteresis and eddy currents to be small as compared with the transformer with closed magnetic circuit.







FIGS. 5, 6 AND 7.

The curve of efficiency is given in Fig. 7, and is seen to rise very rapidly as the load increases, reaching about 90 per cent. at one-eighth of full load; from quarter load it remains practically constant, attaining a maximum of 96.6 at two-thirds load, but drops off slightly on overload. The all-day efficiency, calculated on an average of five hours at full load out of 24 is 91.8 per cent. The regulation, as seen by the curve in Fig. 6, shows a fall of about 2.5 volts in the secondary between no load and full load. The primary current is shown by a curve in the same figure; even at no load it is quite large, although representing very little energy expended. Clearly the disadvantage of such a current is that it increases the losses in the line and in the primary conductor. If this line current can be successfully reduced one of the chief objections to the open magnetic circuit transformer will be removed. This can be done by the use of condensers.

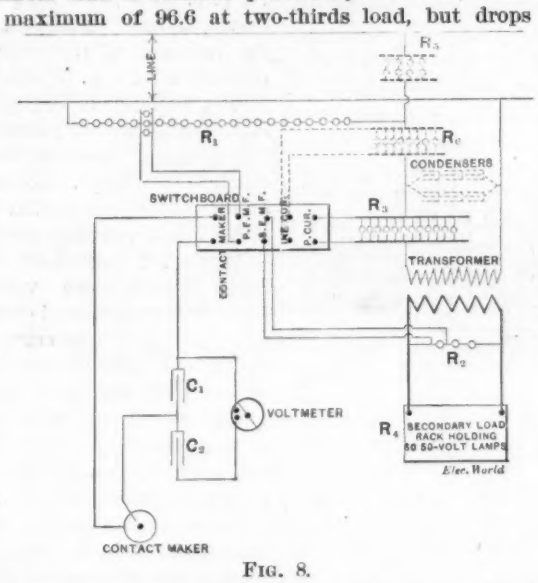


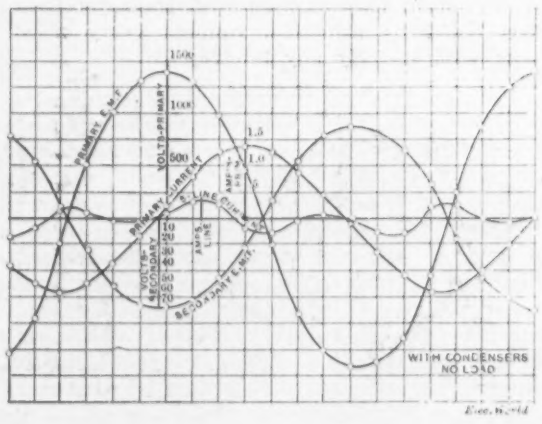
FIG. 8.

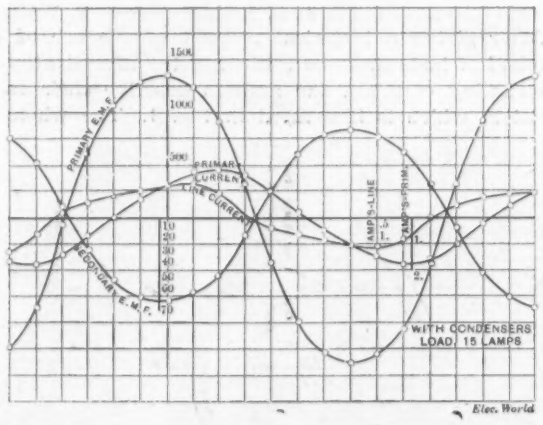
A series of experiments substantially the same as those just described were made with the addition of a set of condensers of proper capacity placed between the terminals of the primary in order to reduce the line current. Referring to Fig. 8, the resistance R_5 was introduced to lower the potential supplied the transformer in order to prevent further breakage in the secondary lamps. The resistance R_6 was used to measure the line current—that is, the current supplied to the transformer and condenser. Six Stanley condensers were used, the capacity of each being about 1.5 microfarads, and their efficiency was found to be about 96.9 per cent. By arranging the condensers in various combinations it was possible to obtain a number of different capacities ranging from .25 to 2.25 microfarads, without subjecting any one condenser to more than the 500 volts P. D. for which they were all designed. The proper capacity of the condensers was ascertained by trial as follows: The transformer was run on open circuit with the condensers arranged in various combinations, so as to obtain different capacities, and the fall of potential around the incandescent lamps, R_5 in the line was measured for different capacities and plotted; the minimum drop occurs when the current is a minimum and in phase with the E. M. F., which was at a capacity of almost one microfarad, the same as was also calculated. The six condensers were therefore used three in series and two in parallel, giving a capacity of 1.02 microfarads. Three runs were made with no load and 15 and 35 lamps respectively, and the results are given in the following table, showing clearly the effect of the condenser in diminishing the line current, especially at no load:

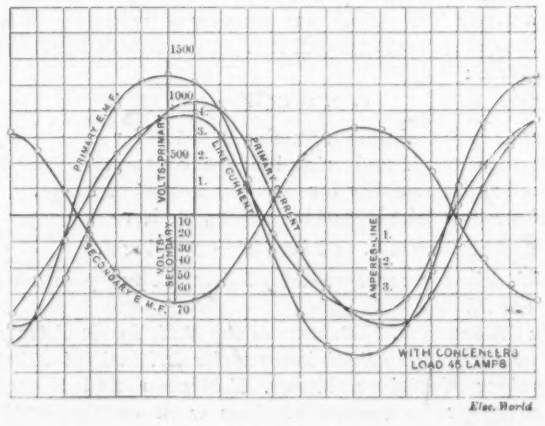
Lamps in secondary.	Primary current.	Line current.
0.	.95	.187
15.	1.24	.867
45.	3.07	2.73

At no load the line current seems to be less than one-fifth of the primary current, or the value it would have if the condensers were absent; even under full load the reduction is considerable.

The results of the three runs are shown by the curves in 9, 10 and 11. The line is the algebraic sum of the primary and condenser currents, and if these currents were harmonic it would be in phase with the E. M. F. if the condenser were properly proportioned. In Figs. 10 and 11 this is seen to be practically the case. The irregular character of the line-current curve in Fig. 9 is explained thus: It is the algebraic sum (the arithmetical difference) of two almost equal and opposite currents, and is very small compared with either. If these two currents were exactly sinusoidal the resultant curve would be sinusoidal. As a matter of fact, although very nearly sinusoidal, they are not exactly so, and these variations have a marked effect upon their resultant, which is their arithmetical difference. The line-current curve has a marked depression, which brings the portion which would naturally be the crest over the axis; that is, for a brief interval in each half period it has the opposite sign, and the current flows in a direction opposite to its flow during the other part of the same half-period. With a load of 15 lamps this depression has a slight effect, but is scarcely noticeable for a load of 45 lamps, the line-current curve in Fig. 19 differing but little from the primary current curve. It is ahead in phase, and with harmonic currents and the exact capacity required it would be in phase with the E. M. F.



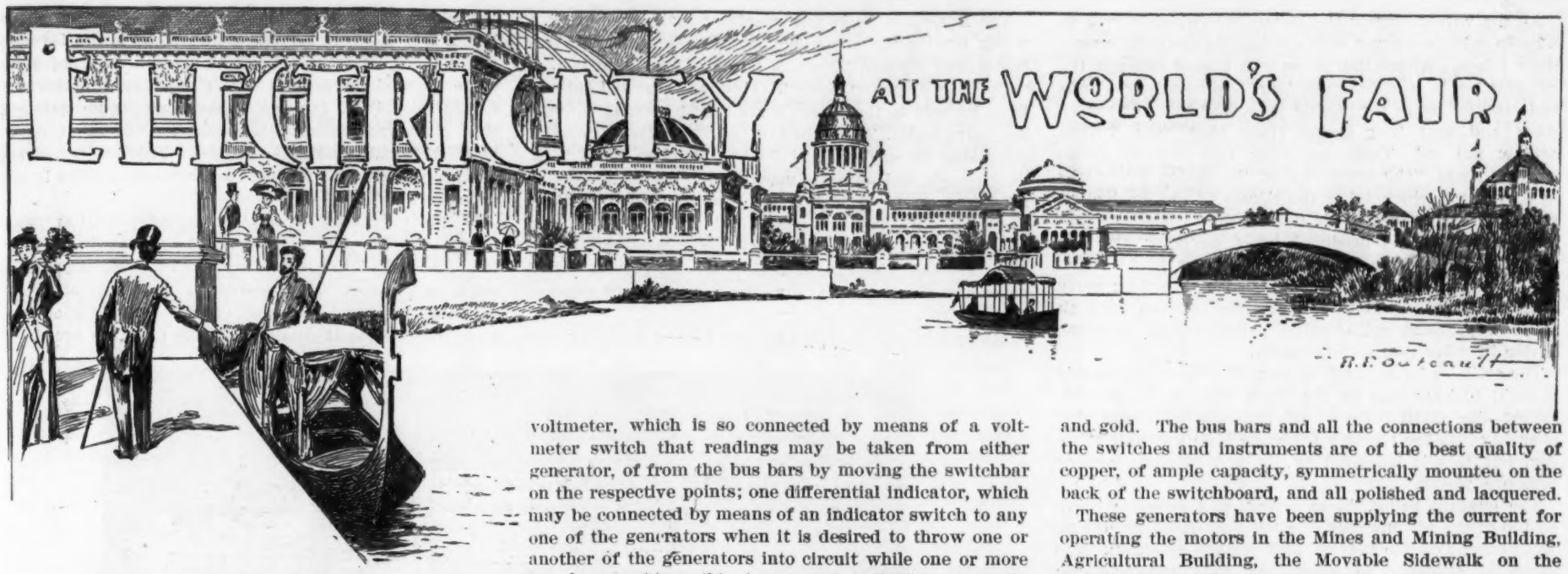




FIGS. 9, 10 AND 11.

A series of experiments substantially the same as those just described were made with the addition of a set of condensers of proper capacity placed between the terminals of the primary in order to reduce the line current. Referring to Fig. 8, the resistance R_5 was introduced to lower the potential supplied the transformer in order to prevent further breakage in the secondary lamps. The resistance R_6 was used to measure the line current—that is, the current supplied to the transformer and condenser. Six Stanley condensers were used, the capacity of each being about

The results of the experiments show the transformer upon which the investigation was made to possess two valuable features—high efficiency and good regulation. The experiments with the condensers demonstrate the practicability of their use to diminish the line current in transformer circuits, and point to their more extended use, as their manufacture is perfected and cheapened, not only in this but also in other systems of alternating current distribution.



A MODERN POWER PLANT.

In Section C, Space 8, Machinery Hall, is a very interesting example of a modern power plant which was installed by the Mather Electric Company, of Manchester, Conn.; it is not only intended for an exhibition of this company's apparatus, but it is practically applied to the operation of motors in various parts of the Exposition grounds. The plant consists of two compound wound electric power generators, with a capacity of 225 kw. each, and working at a potential of 550 volts, at a speed of 450 revolutions per minute; and two compound wound electric power generators, of 120 kw. capacity each, and working at the same potential but making 525 revolutions per minute.

The 225-kw. generators are six-pole machines with field magnets and armature supports cast in one piece without joints, except between the upper and lower half of the field.

The winding of the armature is such that there are only two paths for the current through the armature, and yet opposite bars of the commutator are connected and so maintained always exactly at the same potential. The commutators are cross-connected and it is impossible to use all the sets of brushes, or any two sets, as may be desired.

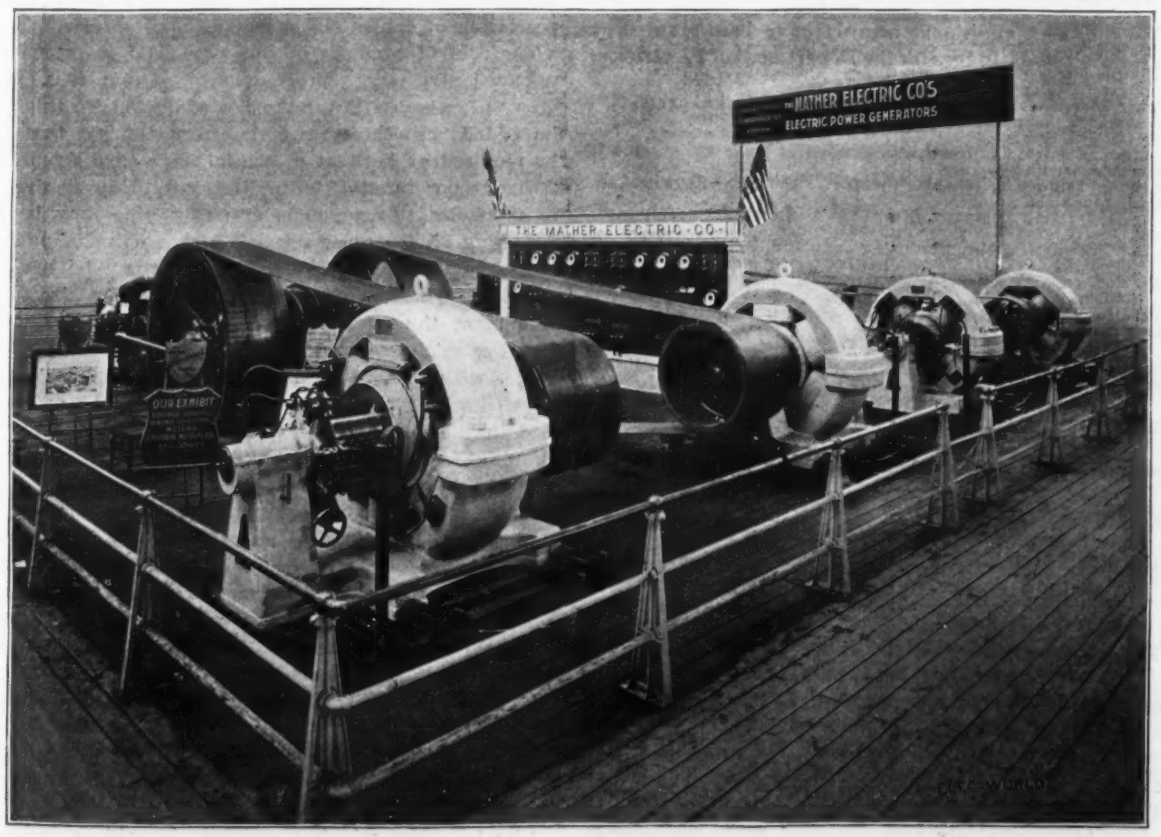
The generators are mounted on sliding iron bases fitted with four screws, connected together in pairs by means of a chain and operated by ratchets, so that the generator can be kept in perfect alignment and the tension of the base regulated. The base frames are firmly bolted down to the foundation, which in this case is made of heavy timber and hard burned brick laid in Portland cement.

The four generators are connected to one set of bus bars, so that all the machines can be operated in multiple when desired. The switchboard, to which these generators are connected, is composed of slate slabs set in a steel frame, making the switchboard self-contained. On the switchboard are mounted: four rheostats; four triple-pole switches through which the generators are connected to the bus bars; four ammeters which record the quantity of current generated by each machine; one voltmeter, which is so connected by means of a voltmeter switch that readings may be taken from either generator, of from the bus bars by moving the switchbar on the respective points; one differential indicator, which may be connected by means of an indicator switch to any one of the generators when it is desired to throw one or another of the generators into circuit while one or more are in operation, this instrument indicating correctly when the machine to be thrown in circuit attains the proper potential. There are four double-pole single-throw switches, through which the circuits are connected to the bus bars; four ammeters, which show the quantity of current used on each circuit, and the circuits are protected by means of double-pole safety cut-outs, which carry a fusible strip of suitable capacity, and are further protected by means of the automatic adjustable circuit breakers mounted on separate frames behind the switchboard. The switchboard is encased in a massive framework of pure Doric style, and finished in white enamel and gold. The bus bars and all the connections between the switches and instruments are of the best quality of copper, of ample capacity, symmetrically mounted on the back of the switchboard, and all polished and lacquered.

These generators have been supplying the current for operating the motors in the Mines and Mining Building, Agricultural Building, the Movable Sidewalk on the pier, the Mather Electric Company's exhibit plant, in the Electricity Building, and other motors. The generators are all finished in white and gold, the whole plant presenting a handsome and imposing appearance.

These power generators are particularly adapted to street railway work, mining work and factory power plants, their regulation being superior and their efficiency at the highest point.

A FAVORITE ENGLISH HIGH SPEED ENGINE.



A POWER PLANT IN MACHINERY HALL.

THE WILLANS ENGINE AT THE FAIR.

In the long list of engines exhibited at the World's Fair, embracing, as it does, almost every conceivable form and make of machine, there is none which has attracted more genuine interest than the famous English engine, known as the Willans engine.

The principal exhibit of this machine is to be found in Machinery Hall, being the first the visitor sees as he enters through the northwest doorway. It embraces two engines, one being coupled to a Siemens dynamo.

In Electricity Building two of the same make of engine occupy conspicuous positions. One is displayed in the exhibit of the General Electric Company, and the other in that of the Brush Electric Company. The well known firm of Bullock & Co., of Chicago, have secured all American rights to the engine, and are now promoting its interests here.

The engine consists of two tandem engines, single acting, with cranks set at an angle of 180 degrees, being something on the style of the Westinghouse automatic. Each engine has a central valve chamber, and the single valve rod carries five valves, the valve chamber passing through the pistons of each engine. Two piston rods connect the pistons of each engine, the rods being hollow, with steam ports through which the steam can enter and leave the cylinders.

The eccentric is forged solid on the pin, not the shaft, as is usually done. The reason for this is that the valves and piston both have parallel movements, and the piston rod carries the steam ports so that valves and ports both move.

The valves are of the piston type, and each rod is provided with six, the lower one serving as a guide to take the thrust of the eccentric, the top one to separate the steam chest from the cylinders, except when the top ports are open, when it serves also to carry the steam pressure and keep the eccentric strap pressed against the eccentric, thus preventing pounding if the strap is loose on the eccentric.

All the valves, except the lower one (which serves as a guide only), are fitted with spring rings to make steam-tight joints. Where the piston rod passes through the cylinder heads a steam-tight joint is secured by glands and stuffing boxes containing phosphor bronze packing rings and cast iron spring rings that pass inward against the rod. These are after the style of piston packing rings. The lower end of the piston rod works in a cylinder which takes the thrust of the connecting rods, and serves to provide the required cushion.

The regulation is produced by a governor attached to the shaft and consisting of weights or flyers which act through a bell crank and control a throttling valve in the steam pipe. There is a receiver between the high and low pressure cylinders corresponding to the same device in other compound engines.

The cylinder being single acting, the steam pressure is brought to bear only on the upper side of the pistons, except the small pressure of the exhaust steam discharging into the receiver from the high pressure cylinder, but this is balanced by its pressure on the low pressure piston.

The engines being single acting, and pressure being on top of the pistons only, the main bearings receive no wear except on the bottom, and require no strong caps to resist thrust. The connecting rods and eccentric have a continual downward pressure, and are consequently fitted with wearing metal only on the top portion. In case the engine should for any reason race, the parts might be raised from the bearings, when slight knocking occurs, but this would cease as soon as the load was thrown on again.

Any water that might enter the cylinder with the steam is drained away from the high pressure cylinder through the ports to the receiver, and from the low pressure cylinder through the ports to the exhaust chamber. Each cylinder is also fitted with spring relief valves to insure the safety of the engine in case an excessive amount of water should get into the cylinders.

The stroke of the pistons is less than the diameter of the high pressure cylinder, thus permitting of high speed.

Automatic regulation of the engine is provided for by inclosing the lower parts so that the shaft is partly submerged in oil. The depth of oil in this chamber is sufficient to partly cover the cranks and eccentric at every stroke, and the upper connection of the connecting rod is lubricated by the spray of oil carried upward by the splashing of the cranks in the reservoir. The guides of piston and eccentric are lubricated in the same way.

All working parts can be readily reached, when repairs or adjustment are necessary, by simply removing caps or breaking joints, as this feature was fully considered in the design. Renewals can be easily made, as all parts are made in duplicate.

An engine of this type, having cylinders 9¾ and 14 inches, with 6-inch stroke, making 460 revolutions per minute with 120 pounds of steam, will develop 80 indicated h. p., giving 72 actual h. p.

The combination of this engine with any electrical generator affords at once a machine that is compact, convenient, capable of constant work, and very economical.

THE EXHIBIT OF THE CROSBY STEAM GAGE AND VALVE COMPANY.

One of the exhibits of the World's Columbian Exposition which attracts attention by its tasteful arrangement and the excellence of material and workmanship embodied in the various pieces of the apparatus displayed is that of the Crosby Steam Gage and Valve Company, of Boston, Mass. Among the many specialties in the line of steam appliances included in this exhibit and for which special merits are claimed are the Crosby improved steam gauge, Crosby pop safety valve and water relief valve, Meady muffled pop safety valve, Crosby steam engine indicator, Bosworth pump governor and feedwater regulator, patent gauge tester, etc.

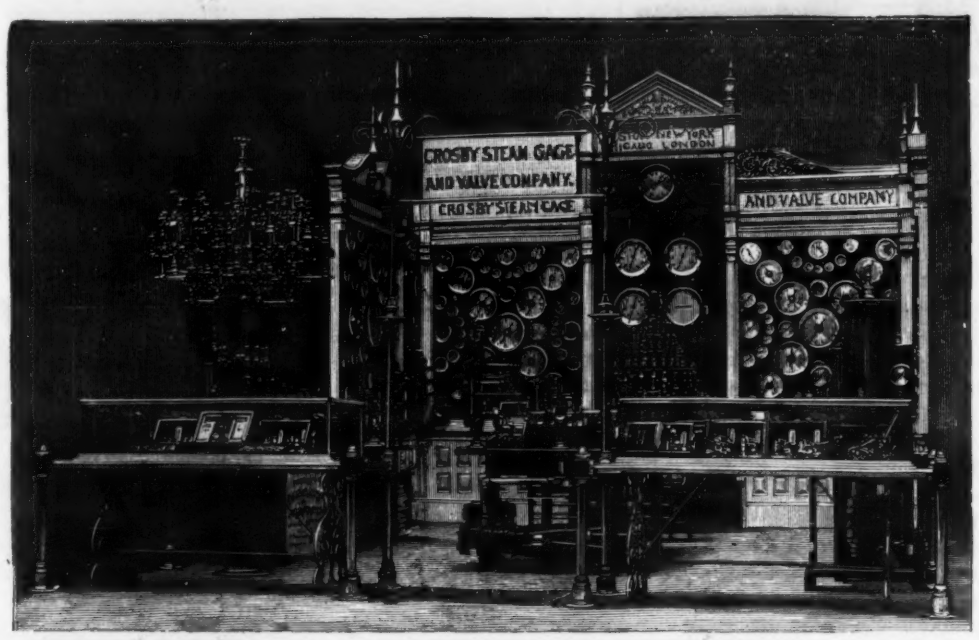
In the Crosby improved steam gauge the hollow double spring is so arranged that the vertical as well as the horizontal movements of its free end are utilized so that ample movement of the pointer is obtained with only half the motion ordinarily required, and consequently a very much stronger spring can be employed. This may be considered a special feature of the gauge and is a most important one, as a stiff spring results in steadiness of the pointer, and the tendency to "set" is practically eliminated. The Crosby gauge was introduced some 20 years ago and has always maintained its high reputation.

For locomotives, stationary, marine and other boilers the Crosby pop safety valve is intended as a perfect protection and it can be relied upon to act automatically at the right time with but slight loss of pressure. The Crosby water relief valve is intended to relieve all overpressure of water in steam pumps, fire engines, hydrants, etc. One of the well known products of this company is the Crosby steam indicator. The old type of indicator, with modern high speed engines is of little use. The Crosby indicator is specially adapted for high speed work and is fitted in every way to meet the requirements of modern practice. The Paris Exposition in 1889 recognized its superior qualities when it awarded it a gold medal, the highest award, and the identical instrument which received that honor is a part of this exhibit.

The Bosworth feedwater regulator maintains an even water line in the steam boiler with much greater precision and certainty than is possible for an attendant to do. The Johnston blow-off valve can be moved entirely from its seat so that there is a straight opening through the valve body. The sliding of the valve under pressure maintains its surfaces and its seat in close contact. A very simple and accurate machine for testing gauges of all kinds is the patent gauge tester. These machines are made with extreme care and thoroughly tested, and have many points of superiority over a mercury column, They are also a safeguard against gauges getting out of order and are claimed to save much trouble and expense for repairs.

The exhibit also includes various gauges made for special purposes, such as: hydraulic, for hydraulic pressure; vacuum compound, showing both pressure and vacuum; combination, for water-works, showing both pressure of water and the height of column; ammonia, for use in refrigerating or ice manufacturing plants; chemical, for use on chemical engines, or wherever the use of the ordinary gauge is precluded; ordnance, for use on pneumatic gun carriages for measuring the high pressure suddenly produced in the recoil chamber when the gun is discharged, and this it does successfully and without harm to the gauge, when an ordinary gauge would be utterly destroyed; gas governor, to regulate the flow of gas to a vulcanizer or other vessel or boiler; pyrometer, to show both the pressure on the train and in the reservoir; altitude, for showing both the pressure of steam and the height of water in the tank or reservoir in hot water heaters; standard test gauge; engine register or counter; engine-room clock, etc.

This company has its main works and office at Boston, Mass., with branches in New York, Chicago and London.



A DISPLAY OF WELL-KNOWN GAUGES AND VALVES.

Additional Awards at the World's Fair.

The following additional awards have been granted by the Committee of Judges for the Department of Electricity:

UNITED STATES.

Brush Electric Company, Cleveland, O.—(8) Historical exhibit.
Graves Arc Lamp Company, Cleveland, O.—Arc lamps.
N. S. Keith, San Francisco, Cal.—Constant current motors.
Mather Electric Company, Manchester, Conn.—(2) Automatic adjustable circuit breakers.
National Engraving Machine Company, Chicago.—Jewelers' engraving machine.
Standard Paint Company, New York.—Insulating compound, liquid.
S. S. White Dental Manufacturing Company, Philadelphia, Pa.—(2) Application of electricity as a motive power for electric drills.
Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.—(15) Electric meter, "Shallenberger"; (16) Constant potential, alternating current arc lamps; (17) system of arc lighting by alternating current.

GERMANY.

Siemens & Halske, Berlin.—(4) Cored carbons.
Schuckert & Co., Nuremberg.—(5) Registering wattmeters.

GREAT BRITAIN.

General Electric Company, Ltd., London.—(2) Carbons.

ITALY.

Societa Ceramina Richard, Milan.—Insulators.

JAPAN.

Eizaomon Tukagawa, Saga.—China insulator.

Some Practical Points in the Construction of Underground Feeders for Electric Railways.

Abstract of a paper prepared for the Milwaukee Convention.

The paper prepared by Prof. D. C. Jackson on the above subject was not read at the meeting of the American Street Railway Association, owing to the absence of the author, but the Executive Committee ordered that it be incorporated in the "Proceedings."

Prof. Jackson considers the two systems—"built in" and "drawing in"—of underground construction, and the various kinds of ducts that are used with the second, and states that the use of the first is generally not advisable. Iron pipe, laid in concrete, is the most expensive form of duct, and experience has shown that the adoption of this expensive form is usually not necessary, except for use in making bends. He pronounces ordinary cement or vitrified clay sewer pipe, laid in concrete, as probably the most satisfactory conduit for light feeder lines, as well as for use where a number of feeder lines are to be laid in the same street, in conduits with several ducts. A number of sewer pipes bunched in concrete may be used. Wood is the favorite material for conduits in Philadelphia, but does not seem to be adopted for general use. For heavy or important feeder lines Prof. Jackson thinks there is no question that plain and cement lined conduits are the ones to be used. Small manholes are advised for electric street railway purposes, as frequent access to the cables is not necessary.

As to the cables, Prof. Jackson advises that those larger than No. 4 B. & S. should be stranded, and that it is economical to use one standard size throughout as much as possible. The question of insulation of cables is considered, and the use of fibrous insulation not recommended, as it cannot be made moisture proof. It is advised to use an airtight sheath such as furnished by rubber or lead. To protect the lead sheathing from mechanical injuries requires a good conduit and careful handling. As to chemical action, alkalies, creosotes and other wood preservatives attack it, and the electrolytic action may cause trouble; this latter may be avoided by properly connecting the lead sheath to the rail and to the ground terminals of the dynamo. To protect from destructive chemical action, the lead is often alloyed with small proportions of tin and antimony, and tin plating is often resorted to. As a matter of protection it is well to both alloy and plate the lead; sometimes a braided covering soaked in a preservative compound is used, but this rots off so quickly that it may be positively harmful.

Attention is called to the importance of joints, and some detailed information on this subject is given. The maintenance of underground cables should be small if proper attention is given to testing and repair of faults before they become breakdowns, and if properly installed under fair conditions experience seems to show that five per cent. is sufficient to allow for depreciation of cables and conduits.

The cost of conduits of iron pipe, laid in concrete in unpaved streets, is, in cents per running foot, about $25 + 24d$, where d is the number of ducts. To this must be added the cost of repaving, any charges that may be required on account of special work, and from 12 to 20 cents per running foot of conduit to cover the cost of manholes. Single ducts of sewer pipe may be laid for about 35 cents per running foot, not including manholes or repaving. Wooden conduits may be made to cost less. The cost of cables depends on the size of the conductor, the thickness and quality of the insulation, and the thickness of the lead. A number four naught cable, with insulation about 5-32 of an inch thick and covered with 3-32 of an inch of lead, may be ordinarily laid in the conduits for between 50 and 60 cents per running foot, unless an excessive amount of special work is required.

Even for heavy underground lines the annual cost (interest + depreciation + maintenance) is three or four times that of lines of equal capacity placed on good overhead construction. In many cases this means a considerable increase in the cost of carrying passengers. How far increased reliability in service and satisfaction to property owners can be counted against the increased cost can only be decided in each individual case. In many cases it means bankruptcy for the company, but in a smaller number it means a manifest gain.

Hardening Aluminium.

The hardness which aluminium is said to lack can, according to a new process, be imparted to it by the addition of chromium. Of course certain precautions have to be taken to alloy the two metals, owing to the difference in their fusing points. If electrolysis is employed for this purpose, one or another of the known methods can be used, and the alumina, salts of alumina, cryolite, etc., treated direct with a determined quantity of granulated chromium or chromium in any other suitable condition, or with its salts or oxides.

THE ELECTRICAL WORLD'S DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Prof. Lodge's Electro-magnetic Hypothesis.—Prof. Poynting's article is concluded in the Lond. "Elec.," Oct. 13; he discusses the foundations for the hypothesis "to see if they are sufficiently firm to bear the superstructure"; he states that Lodge's hypothesis and its accompanying models are to be used rather as illustrations and as analogies than as ultimate solutions. He suggests that progress is likely to be made by leaving ether out of account for the present, and by considering the magnetic and electric relations of molecules as those of large masses. The same number contains an editorial on this subject.

Plane of Polarization of Hertzian Oscillations.—"La Lum. Elec.," Oct. 14, contains an article on this subject by Mr. Righi, in which he draws the following conclusions: his experiments with the metallic reflection of the oscillations tend to show that the plane of polarization of electric oscillations is perpendicular to the direction of the magnetic forces, that is, parallel to that of the electric forces; but the experiments with reflection and refraction in dielectrics, on the contrary, tend to show that the plane of polarization is perpendicular to the direction of the electric forces; the second being in accord with theoretical results, he thinks it is preferable to consider it as the true conclusion.

Propagation of Light in Metals.—The article of Mr. Raveau, mentioned last week, is continued in "La Lum. Elec.," Oct. 14. In it he describes his experiments, the results of which are given in curves and figures. Among other things he says that the velocity of light in silver is about four times as great as that in vacuum, and that the dispersion is very slight; in gold and copper the velocity is also greater than in vacuum and the dispersion is normal; in platinum, iron, nickel and bismuth the dispersion is quite normal.

Reversals in Influence Machines.—Mr. Muras in the Lond. "Elec. Rev.," Oct. 13, states that the reversal of a Toepler-Holtz machine appears to be due to the accumulation of opposing charges on the inside of the stationary plate, opposite the neutralizing brushes; he finds that it can be completely prevented by applying foil and paper coatings to the inner surface of the stationary plate, and connecting them by strips of foil to the charging rods; the spark length is somewhat reduced thereby, owing to the leakage from the inside coatings to the surface of the rotating disc.

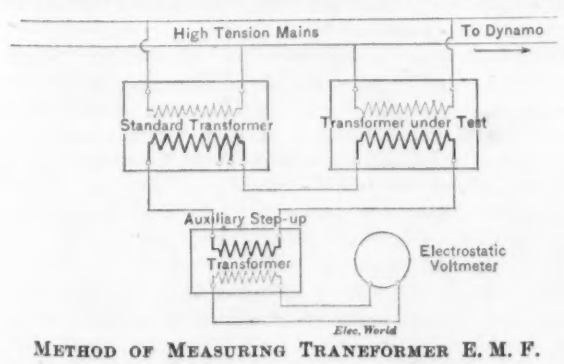
High Frequency Discharges.—Mr. Swinton's paper in the "Phil. Mag.," mentioned in the Digest, Oct. 21, is reprinted in the Lond. "Elec. Rev.," Oct. 13.

Specific Inductive Powers of Bodies and Their Refractive Indices.—"La Lum. Elec.," Oct. 14, publishes an article on this subject from the Italian by Mr. Pagliana.

Magneto-optical Rotation.—"La Lum. Elec.," Oct. 14. reprints an article on this subject by Mr. Gray, from "Nature," Aug. 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the E. M. F. of Transformers.—Mr. Scattergood, in the first part of an article, published in the Lond. "Elec.," Oct. 13, describes a sort of potentiometer method of measuring the E. M. F. of transformers. In a factory in which the speed of the dynamos is not constant, testing transformers is not easy; to overcome this difficulty he devised this method which, he says, developed some interesting results. The arrangement in general is shown in the adjoining cut, which explains itself; the secondary of the



METHOD OF MEASURING TRANEFORMER E. M. F.

transformer, whose open circuit E. F. M. was to be measured, was connected in series with that of a standard transformer, of which the secondary E. M. F. at the normal primary voltage was accurately known; they were connected so that the secondary E. M. Fs. are opposed; if the two voltages are exactly equal they balance each other, but if there is any difference a current will flow in the third transformer, giving a deflection in the voltmeter, which deflection is therefore a measure of the difference between the voltage of the standard and that of the transformer under test; as the former is known the latter is at once arrived at. The standard transformer, as shown, has several terminals leading to different parts of the primary winding, thus enabling the voltage to be varied from 90 to 110; as only the difference in voltage is indicated, two readings must be made, using more or less of the standard secondary in order to find which is the greater; with two such tests the true voltage can readily be determined graphically by means of the methods shown in detail in the original. The article is not written as clearly as might be desired. Those interested are recommended to read the original.

In the second portion of his paper, which has not yet been published, he describes a simple way by which the results may be calculated algebraically instead of graphically; he states that an error in the calibration of the voltmeter will make practically no difference in the accuracy of the results obtained, as the only effect will be to alter the slope of a certain line, but not its intersection, which is the point to be found; the degree of accuracy obtainable is limited solely by the conversion ratio of the auxiliary transformer used; with a step up ratio of 1 to 20, and with an accuracy of $\frac{1}{4}$ of a volt in the reading of the voltmeter, the possible error is only $\frac{1}{15}$ of a volt, which with 100 volts is an accuracy of one part in 8,000; the great advantage of the method is the possibility of obtaining rapid and sufficiently accurate measurements under conditions which would ordinarily make such measurements impossible; with the primary voltage unsteady or wrongly estimated, or both, and with an incorrect voltmeter, it is still possible to get measurements which are quite sufficiently accurate for all practical purposes. He suggests a modification by using an electio dynamometer of fairly high resistance in place of the step-up transformer and voltmeter, a method which is not so sensitive and has the disadvantage that the readings are affected to a much greater extent by the frequency of the alternations, and therefore by the variations of the dynamo speed, but it is simpler and will often be found convenient, especially where great accuracy is not desired. He also finds that besides being applicable to the measurement of open circuit voltages, his method could also be applied to that of a loaded transformer, giving quite satisfactory results, and by means of which the lag of the primary current behind the primary voltage, and therefore the power factor of a transformer at different loads, can also be measured readily. The connections for this test are precisely like those shown in the figure, except that a load of lamps or a non-inductive resistance is placed across the secondary terminals of the transformer under test, with an ammeter in circuit to measure the current; the effective E. M. F. in the circuit, as measured by the voltmeter, in this case never becomes zero, but falls to a minimum and then rises again; he describes this at some length and illustrates it with an example. In conclusion he states that the method appears to be capable of considerable further development, of which as well as of other practical applications, he promises to say more on a future occasion.

Cadmium Mercury Standard Cell.—Mr. Dearlove, in the Lond. "Elec.," Oct. 13, describes at some length a long series of tests made with the Weston standard cell, a number of which were made and tested carefully by that writer. At first he obtained no satisfactory agreement, but he found that the proportions of the cadmium and the mercury in the amalgam had a very important bearing on the result; until a proportion of 7 parts of mercury to 1 part of cadmium was reached the results were unsatisfactory. His conclusions are as follows: a more extended experience with the cell is necessary before it can be regarded as a possible rival to the Clark cell; that the cell is easily set up, and that considerable accuracy is attained; that separate workers, using different materials, arrive at practically identical results; that the cell submits to rough treatment, and maintains its voltage constant; that the low, and almost negligible temperature coefficient, amounting to one-tenth of that of the Clark cell, is an important addition. He states that as designed by Weston it is not portable, but that he, Mr. Dearlove, has designed a portable type, in which the cadmium amalgam electrode is either cast round a platinum spiral or packed into a perforated glass tube, the free mercury electrode being replaced by an amalgamated closely wound platinum spiral.

Phase Meter.—"La Lum. Elec," Oct. 14, describes and illustrates an apparatus for measuring the difference in phase between two currents, devised by the Allgemeine Elektricitaets-Gesellschaft of Berlin. It consists essentially of two coils perpendicular to each other encircling a metallic disc capable of rotation and opposed in its rotation by a spring; a needle is attached to it, by means of which the deflection may be read; the two currents are sent through two coils, producing a magnetic field, and if there is a difference of phase they will exert a rotating force on the metallic disc.

DYNAMOS AND MOTORS.

Improvement in Dynamos.—The Lond "Elec. Rev.," Oct 13, describes and illustrates, with the aid of two illustrations, a recent improvement brought out in England, which consists in arranging the two magnets of an upright machine so that they may be moved out horizontally and perpendicularly to the shaft, by means of screws, so that they no longer embrace the armature, thereby permitting both the armature and the field coils to be readily removed for repairs.

TRANSFORMERS.

Direct Transformation of Alternating Into Continuous Currents.—The system and apparatus of Mr. Pollak, described in the Digest Aug. 5, is described in detail and illustrated in "La Lum. Elec.," Oct. 14.

ARC AND INCANDESCENT LIGHTS.

Incandescent Lamps.—In his serial on incandescent lamp manufacture in the Lond. "Elec.," Oct. 13, Mr. Ram discusses the subject of efficiency, giving also a curve of the per cent. of candle power for different percentages of volts, 10 per cent. above and below the normal, and which is said to be nearly correct, whatever be the temperature or efficiency of the lamp at normal voltage. He describes a test in which a lamp was run until blackened, after which the filament was removed and placed in a new globe, after which the lamp was again tested; the lamp originally gave 55 candles for 107.7 watts at 51.7 volts, that is, at about two watts per candle; he thus found that the increase in emissivity of the filament was 23.6 per cent., the increase in resistance 21. per cent. and the loss due to the blackened glass 33.6 per cent.; a total of 78 per cent.; although this lamp had been very much over run, he believes the same kind of result will undoubtedly occur in lamps run at ordinary temperatures. He believes that if a filament could be found whose resistance gradually fell as the emissivity increased and the bulb blackened, a lamp of uniform candle power or of uniform watts per candle power throughout its life might be possible.

Lamp Holders.—The Lond. "Elec.," Oct. 13, gives the first part of an illustrated article showing the earlier forms, presumably in view of the expiration of the fundamental lamp patents in England in November.

Vacuum Pump.—The Lond. "Elec. Rev.," Oct. 13, describes and illustrates the vacuum pump in the form used for factory purposes designed by Mr. Kennedy. It is an improved Geissler pump, and there are no taps or joints exposed to the perfect vacuum and no valves except the mercury seal.

Heat Produced by Various Lights.—In a paper recently read by Mr. Dicke, mentioned in the "Elek. Zeit.," Oct. 13, he gives the following figures for the heat generated per candle with different lights. With bat-wing or fish-tail burners of 15 c. p., 50 calories; with argand burners of 30 c. p., 44 calories; with a medium sized Siemens regenerative burner of 530 c.p., 23; with an Auer incandescent gas light of 50 c. p., 10.6; with another of 140 c. p. using water gas, 6.7; for the electric incandescent light of 16 c. p., 3 calories.

TRANSMISSION OF POWER.

Transmission of Power from Central Stations.—The first part of Prof. Unwin's second lecture is given in full in the Lond. "Elec. Eng.," Oct. 13, and an abstract of it is given in the Lond. "Elec. Rev." of the same date. In it he discusses the storage of energy and the development of energy by water power. Regarding battery storage he calculates that the cost of the cells amounts to about $100 per horse power based on the maximum rate of working, or to $40 per horse power hour stored; and that the annual cost, including five per cent. interest and 12½ per cent. depreciation and maintenance, will be nearly $85 per horse power of average rate of working of the station; in a proposal for a German station he states that the capital cost for the batteries per horse power hour of storage capacity was $115, or $390 per horse power based on the maximum rate of working. He also discusses the Halpin thermal storage process.

ELECTRIC RAILWAYS.

High Speed Railroading.—The Lond. "Elec. Rev.," Oct. 13, discusses the pamphlet by Mr. Behr on this subject, which was noticed briefly in the Digest, Oct. 7. After giving a short abstract of it, with comments that are not unfavorable, the question is discussed whether such a road is wanted, but without suggesting any points which would be of importance in this country.

Feeders for Railway Circuits.—"L'Elec.," Oct. 7, contains a short article on this subject by Mr. Dieudonne, which, however, contains nothing new.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Coupling Alternators in Parallel.—Mr. Staner, in "L'Elec.," Oct. 7, gives the first part of a mathematical discussion of this subject, which is intended to determine the conditions which should be complied with in order that the coupling of the alternators may be as stable as possible; he treats the subject algebraically and graphically, and comes to the following conclusions: That the external circuit should have as small a self-induction as possible, a condition which is at the same time a favorable one for the transmission of the energy; that the alternators should have as low an internal resistance as possible, which is also a condition favorable for efficiency; that the co-efficient of self-induction of the alternators should have a certain value for which he gives the equation; in case the self-induction of the external circuit is negligible, this equation reduces to $m\,l = \sqrt{r\,R'}$, in which m is equal to $2\,\pi$ divided by the time of the duration of one period, r the internal resistance of the alternator and R' equal to the sum of the internal resistance and twice the external, in case there are two alternators; this value of l is low and approaches the co-efficient of self-induction of armature without iron.

Gas Engine Accumulator Stations.—The Lond. "Elec." Oct. 13, publishes an abstract of a pamphlet already mentioned in the Digest, Oct. 7. Regarding gas engines, it is stated that the old rule that one cubic metre develops one horse power is now erroneous, as quite small engines now require only .8 and large ones .65 cubic metre, besides which they are now built in much larger units. The pamphlet advocates the use of small independent stations with gas engines and accumulators in place of sub-stations with

accumulators fed from central stations through special conductors; it works out a scheme for lighting a town of about one hundred thousand inhabitants from two stations, the gas and electricity works' offices being supposed to be in common; charging 20 cents per kilowatt hour, the interest on the capital, after paying all expenses, would be about 17 per cent., at 17.5 cents it would be 13 per cent. and at 12 cents, about 4 per cent.

Gas Versus Electricity.—The Lond. "Elec.," Oct. 13, publishes in abstract an address of the president of an association of gas managers, which is very unfavorably commented on in that as also in other journals; if his information regarding gas consumption is as inaccurate as that on electric lighting, the article is not worth noticing; it is more of the nature of a wild ranting of one who is behind the times, and knows it.

Train Lighting.—The article mentioned last week is continued in "La Lum. Elec.," Oct. 14. The cost of equipping one first class car with 5 lamps is given as $166, in which the cost of the nine accumulators with accessories is $80; an installation for a gas apparatus for the same car costs that line $204; the operating cost per lamp of 7 candles, based on 7 months' experience, is 2.3 cents, which is quite a little higher than that for other methods.

Electric Lighthouses.—"L'Elec.," Oct. 7, reprints in part a recent paper by Mr. Bochet, consisting almost entirely of a description of the lighthouse building at Armen, in France.

Derby.—The Lond. "Elec. Eng.," Oct. 13, gives a brief description of this station, accompanied by a large number of cuts, showing chiefly the construction of the buildings; the alternating current system is used with the exceedingly small frequency of 40.

Westminster.—In its serial on central stations, the Lond. "Elec. Eng.," Oct. 13, continues its description of this station, in which the three-wire system, continuous currents and accumulators are used.

Bockenheim.—The three-phase installation in this town, mentioned in the Digest Sept. 16, is described in London "Electricity," Oct. 6, with the aid of a number of cuts.

Power from Town Refuse.—Mr. Tomlinson's article is continued in the Lond. "Elec. Rev.," Oct. 13.

WIRES, WIRING AND CONDUITS.

Increasing the Working Capacity of Submarine Cables.—"La Lum. Elec.," Oct. 14, describes and illustrates a new form of cable introduced by Siemens and Halske, which has been in use for some time in the submarine line between Suez and Aden. For the same cross-section the speed of telegraphic transmission in an ordinary underground cable diminishes as the square of the length of the cable: in this new form the length of a cable with the same cross-section and for the same speed of transmission increases in the ratio of 3 to 2. The arrangement is shown in the adjoining cuts, and consists essentially in

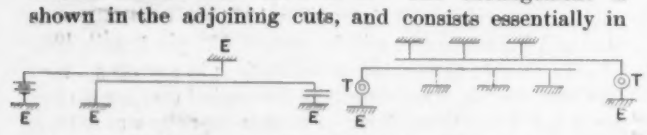


Diagram of New Form of Cable.

using a double wire cable for some distance at the middle of the line, the two free ends being connected to the earth as shown; the double portion will then act as a transformer, its action being increased by the iron armor on the outside of the cable; instead of dividing it into two parts it can be divided into three or more, which will make it better for telephonic purposes; in certain cases, especially for telephony, the arrangement shown in the second figure can be used, in which case almost the entire length of the cable consists of two conductors.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Long Distance Telephony.—The "Elek. Zeit.," Oct. 13, contains an article by Mr. Canter, of the German telegraph department, on the influence of the capacity of the induction coil in loud-speaking transmission; the article is not written very clearly and appears to contain little of importance.

Telegraphic System for Fortresses.—The "Elek. Echo," Oct. 7, concludes the article on this subject by Mr. Nistler, mentioned last week.

Telephone Newspaper.—The "Zeit. fuer Elek.," for Oct. 1, contains an interesting technical description by the late Mr. Puskas, of Budapest, of his novel "Telephonic Newspaper," which was mentioned in the Digest, March 18. This new application of the telephone, which consists in sending news by telephone from one central station to any number of subscribers, was successfully put into use in the city of Budapest, and appears to be still used. He claims that even the modern newspapers do not give the news sufficiently quickly; in his system all the time required in writing, composing, printing and distributing is saved, and all news is transmitted by telephone the moment it is received. As most of the news requires only a few minutes, it is repeated from hour to hour, the "history of the past hour" being added each time. Any subscriber to the regular municipal telephone company can be connected at any time with this news distributing centre. When a listener has finished he hangs up his telephone, which automatically disconnects him from the news station and connects him again with the regular station; the distribution of news begins at the beginning of each hour. The arrangement is such that when connected with the news centre it is not possible for a subscriber to talk or ring his bell, and in that way to disturb the transmission of the news, willfully or otherwise; if it were not for this all the telephones might be connected in multiple to the single induction coil of a transmitter, instead of this, however, the arrangement which he adopts is to have a separate primary and secondary coil for each subscriber, all the primaries being connected in series with the single transmitter; he prefers this arrangement, although they may also be connected in multiple or in series multiple, or there may be several, say ten, transmitters all of which are operated by one speaker, and each of which has ten induction coils, thus supplying 100 subscribers; whenever several are connected in multiple arc the sound in each one will be less the more subscribers there are connected, besides which, two subscribers could then talk with each other, thus interfering with the transmission; it is evident that in his arrangement either grounded circuits or metallic circuits or both can be used; each subscriber's circuit contains an annunciator, which announces that he wishes to be cut off without requiring the ringing of a bell which would interfere with the transmission; instead of speaking the news into a transmitter, he suggests that it might be first inscribed on a phonograph, and then transcribed from it.

ELECTRO-CHEMISTRY.

Chlorine and Soda.—The "Elek. Zeit.," Oct. 13, reprints an article from a mining journal giving the following estimate for a plant in which the Lessueur process is used (this is the same process which is used at Rumford Falls in this country). An installation with a capacity of 18 tons of salt per 24 hours requires two dynamos and engines of 1,200 h. p hour each; assuming the cost of coal to be $2.50 the cost of the power, including an amortization of 10 per cent. for the boilers and machines, will be about $300 per day of 24 hours; the loss of power in the circuits is given as 17 per cent., leaving about 2,000 effective h. p.; this will give a current of 331,555 ampères at 4.5 volts; every ampère hour will liberate 1.32 grams of chlorine and 1.5 grams of caustic soda, so that with an efficiency of 80 per cent. the daily production of chlorine will be about 18,500 lbs., corresponding to about 50,000 lbs. of bleach, also about 20,000 lbs. of caustic soda, which at the prices of to-day correspond to about $1,200. The cost of production, including power, salt, calcium, packing, amortization of dynamos and apparatus, renewing the diaphragms and anodes, and superintendence, is given as about $700; adding to this about $100 interest on the capital gives a profit of about $400 per day. This, the article says, is too favorable to be accepted without question; it believes that it would be only one-half or one-third as great.

The Lond. "Elec. Rev.," Oct. 13, describes at some length the installation of Mr. Andreoli at Bethnal Green, giving also an illustration, which, however, is only a general view. It is not only intended for the production of chlorine and caustic soda, but, with a few modifications, it can be used for the manufacture of chlorates, oxygen and hydrogen; figures comparing it with other processes in use are promised in another article. Some of the features are that the porous diaphragm is made of powdered asbestos baked at a very high temperature; this offers less resistance than clay porcelain and is not disintegrated; the anodes are made of dense retort carbon, and the cathodes of iron perforated with holes; one of the characteristic novelties is that there is a double circulation from the inlet and outlet of each series of positive and negative compartments. Among the advantages claimed are that the circulation, the temperature and the density of the liquid are properly maintained; that the anodes have no metallic parts which may corrode, that there is no chlorine in the negative compartment and no soda in the positive, and that the E. M. F. is low.

Theory of the Accumulator.—In a discussion with several other writers, Mr. Strecker in the "Elek. Zeit.," Oct. 13, describes the following experiment, which is intended to show that the charge of an accumulator is based chiefly on the reduction of the lead oxide and sulphate, to lead, and not on the occlusion of hydrogen by the lead. Two negative plates were charged and then placed as quickly as possible under the receiver of an air pump, being kept there for several days with the air in the receiver exhausted; they were then replaced in the cell and discharged when it was found that they yielded the same discharge as when run under normal conditions. His adversaries, Messrs. Streintz and Neumann, appear to claim that the occluded gases take an important part in the reaction.

Polarization of Platinum Electrodes in Sulphuric Acid.—The Lond. "Elec.," Oct. 13, publishes an abstract of a Royal Society paper by Mr. Henderson, the object of the investigation being to obtain the difference of potential between two platinum electrodes in sulphuric acid immediately after stopping the current and to find how it varied with the current and the strength of the solution; the results show that the polarization is constant with large electrodes, being independent of the current and the strength of the solution; the mean value appears to be 2.09 volts.

Nitrate of Soda Battery.—"La Lum. Elec.," Oct. 14, describes briefly and illustrates with a good cut the Shrewsbury and Dobell battery, in which the electrodes are carbon and iron, and the electrolyte molten nitrate of soda, which is regenerated by passing air under pressure through it; to diminish the polarization air is forced between the plates. (Nothing is said about the amount of power and coal required for the compressed air and for fusing the electrolyte, nor of the total cost of operating, including power and coal.)

Primary Batteries.—The Lond. "Elec.," Oct. 13, contains the first part of a paper by Mr. Cooper on primary batteries in theory and practice. It appears to be well written and illustrated, and can be recommended to students as a good summary although containing nothing new.

MISCELLANEOUS.

Diamond, Boron and Silicon in the Arc.—"L'Elec.," Oct. 7, reprints an abstract of an Academy paper by Mr. Moissan, in which he describes the behavior of these substances if placed in the arc. By starting the arc slowly, and placing a diamond in the crater, it is brought to incandescence and increases in size, covering itself with a black mass formed entirely of graphite. When the diamond is placed in a crucible in an electric furnace it breaks into small fragments, each of which is changed into graphite; the stable form of carbon at the temperature of the arc is therefore graphite; in an oxy-hydrogen lamp at a temperature of 2,000 degrees a diamond was covered with a black coating, but he never obtained any graphite. Boron placed in an arc becomes red surrounded by a green flame and finally disappears without fusion. After the experiment black crystals of boride of carbon were found on the electrode; the carbon of the electrode should be as pure as possible. Silicon fuses and boils when placed in the arc, and after the experiment pale green crystals of a combination of silicon and carbon were found on the electrode; at such high temperatures silicon and boron can therefore be easily combined with carbon.

In another paper in the same journal he describes several methods of preparing a crystallized combination of carbon and silicon; one method is the direct combination of silicon with carbon in the proportion of 28 to 12, heated in his electric furnace; the crystals are often of a yellow color, but may also be transparent and sometimes colored blue like sapphire; the transparent crystals are obtained if the operation is performed in a closed carbon crucible, and if the silicon is as free from iron as possible. In another method silicide of iron is heated in an electric furnace in the presence of an excess of silicon, the iron being afterward removed with acid. Another method is the reduction of silica by means of carbon in the electric furnace. Still another method is by the action of the vapor of carbon on the vapor of silicon in a crucible in the electric furnace. He describes the various properties of this material, the most important of which is that it is extremely hard and will even scratch rubies with ease; its density is 3.12, and it seems to resist acids and high temperatures, but it is attacked by chromate of lead; he gives an analysis of it, showing a proportion of about 70 to 30 of silicon and carbon respectively, corresponding to the formula SiC. (A material which has been produced for some time past in this country under the name of carborundum is said to be a combination of silicon and carbon, and is probably the same thing as the product obtained by Mr. Moissan.)

Electrical Cooking.—The Lond. "Elec. Rev.," Oct. 13, reprints an article from "Science" (omitting, however, the date and number). A detailed series of calculations is given intended to determine the efficiencies of coal and of electric stoves for cooking, and although the calculations are necessarily only very crude they are of some interest. The cooking efficiency, that is the ratio of the heat used in cooking to the total heat in the coal, was found to be three-hundredths of one per cent.; adding to that the heat used in heating the water in the articles themselves, as well as that for washing, the total all-day efficiency was found to be 4.2 per cent.; Prof. Tyndall obtained six per cent.; an analysis of the various losses is given. Similar calculations are made for an electric stove to do the same work, and it is found that as far as actual cooking is concerned, electrical cooking is about 10 per cent. cheaper, but it becomes 35 per cent. more expensive if the water is also heated; he therefore suggests heating the water in a coal heater which will have an efficiency of 50 per cent., and then do the cooking in an electric stove, in which case there will be practically no difference in efficiency; in conclusion it states that the electric oven is bound to come.

Electricity and Vegetation.—Prof Chodat, in a recent paper read at the Physical Society of Geneva, and given in abstract in the Lond. "Elec.," Oct. 13, describes the following experiments: A number of bean seeds, after having been placed in water until the roots became visible, were divided into two lots and planted in two different tubs, one of them being placed in connection with a Holtz machine (but how, is not stated) for about three hours per day; the seeds in the electrified tub sprouted on the fourth day, while those in the other took seven days. Several oxalis plants were taken, some of which were "placed in connection with an electric machine," while the others were not; after this they were all covered with a wooden box, thus shutting out the light; after 20 minutes the electrified plants kept their normal position while the others were drooping; the same was the case when they were electrified immediately before twilight. The sensitive plant is not affected by these electrical influences.

Electro medical Apparatus.—The "Elek. Echo," of Oct. 7, describes and illustrates some new electro-medical apparatus.

A Paradox.

A "dry" cell is so called, because from its very nature it is always "wet," in order to distinguish it from the "wet" cells which, if not attended to, may become "dry."

Mr. Martin's Lawsuit—Its Object Cash, Not Vindication—Fruitless Exertion—Why and How It Failed.—VI.

This week we begin Mr. Johnston's testimony.

He told how the company was organized, and of the concerted action by which it was brought about.

It will be remembered that Mr. Martin swore that the company was not organized to give him an interest in the business, but when pressed he acknowledged that it was created to give him and others.

Why he wanted to quibble about this we don't know.

However, Mr. Johnston showed how the organization of it was brought about, and also what Messrs. Martin, Wetzler and Stump did to bring it about.

This part of Mr. Johnston's testimony was not contradicted. In fact, Mr. Martin did not go to the witness stand at all after Mr. Johnston had testified, and although Mr. Wetzler did become a witness in Mr. Martin's behalf, he did not in any way refer to Mr. Johnston's version of how the company was formed.

Why Mr. Martin refused to admit that the company was formed to give him an interest, and did admit that it was created to give him and others such an interest, we cannot understand, unless, as we said, he merely meant to quibble. Or perhaps the concerted action of these three men was so firmly fixed in Mr. Martin's mind that he was unwilling to admit under oath that this action was ever arranged or undertaken on behalf of only one—himself.

Whatever it was, we think the only inference the reader can draw from Mr. Johnston's testimony is that all three of them were acting on some sort of understanding.

WILLIAM J. JOHNSTON, one of the defendants, was examined by Mr. Keigharn and testified: I am president of The W. J. Johnston Company, Limited, and have been since its organization. The journal known as The Electrical World, or its predecessor, was established in 1874. Mr. Martin first became connected with the paper in 1883. Prior to that he had no experience as editor of an electrical journal. Up to the organization of the W. J. Johnston Company I was the sole proprietor of the business of The Electrical World.

Q. You may state briefly how it came about that you organized the business into a corporation.

Objected to. Overruled.

A. One day in December, 1888, the business manager handed me a letter, signed by Mr. Martin, resigning his position, but dated Nov. 5. I asked him what it meant, and he said that Mr. Martin had handed him that resignation nearly a month before, and that he did not care to present it to me, hoping that Mr. Martin would withdraw it. Mr. Martin would not withdraw it, and insisted upon going, and going at once. I called Mr. Martin into my room, and asked him what it meant. He said: "It means just what it says. I am perfectly satisfied with my salary and the way I have been treated, but I feel that I can make more money in starting out in business in the same line, and others in the office think the same thing; and we don't think we can look forward to a partnership interest in this paper; so we think we ought to have our own business." I said: "Mr. Martin, this is rather short notice, isn't it?" He replied: "It is not my fault. I gave the letter to your business manager a month ago."

Why did Mr. Stump withhold this letter of resignation for over a month?

When we consider the fact that he did so, in connection with the fact that Mr. Wetzler also resigned as soon as Mr. Martin's resignation was presented, and that Mr. Stump himself at once announced his intention of going, too, the action of these three men appears to be something more than a mere coincidence.

Each apparently knew what the other's intentions were, but all the while from Nov. 5 to some time in December Mr. Johnston was kept in ignorance of what they had evidently arranged to do.

I spoke to Mr. Martin, and said that I did not think it was to his interest to leave The Electrical World. I thought there was more money for him to remain with us, and if he would give me a day or two to think it over I would try to arrange some scheme by which we could work together, and he should have some proprietary interest in the journal. He said the matter would have to be arranged quickly. The next day the business manager, Mr. Stump, came to me and said that Mr. Martin was packing up his things, and that he insisted upon an answer at once.

"He insisted upon an answer at once" was Mr. Martin's message, sent by Mr. Stump.

What he wanted was "an answer at once," not to "start out in business in the same line."

I called Mr. Martin, and told him I would arrange the matter as quickly as I could. That same day Mr. Wetzler handed in his resignation, saying he could not remain after Mr. Martin left. Mr. Stump also told me he had received an offer, and that money would be put in the bank to cover his salary for two or three years.

When Mr. Martin's success was assured, Messrs. Wetzler and Stump, encouraged by his experience, promptly followed in his footsteps.

Mr. Martin was always designed for a leader.

The result of the matter was that the W. J. Johnston Company, Limited, was established, and Mr. Martin, Mr. Stump, Mr. Wetzler and Mr. Hunt were given a certain stock interest in it.

Counsel for the plaintiff moved to strike out the answer on the ground that the greater part of it is immaterial and irresponsive. Motion denied.

Mr. Martin wanted this answer stricken out. He wished what it said unsaid. Why? It was the truth; he never attempted to dispute, much less contradict it.

This answer disclosed how the W. J. Johnston Company came to be organized—that it was brought about by what is commonly called "a strike," though Mr. Johnston apparently did not so regard it at the time.

Mr. Martin said he wanted to go into business for himself; that he could make more money; but when he secured what the organization of the company gave him—the result of his "strike"—he was not, for the time being at least, any longer troubled about going into business "for himself."

He had not apparently up to this time, and after nearly eight years' constant daily intercourse and familiarity with Mr. Johnston, discovered what he told Mr. Knight about a year afterward, that Mr. Johnston would deceive Mr. Knight as he had deceived him, and was not to be trusted.

It is strange how one year brought so much knowledge on this point, which the eight preceding years had failed to bring.

Whatever all this may have been worth to him, however, he would to-day be entitled to be considered a wiser man had he lived up to the agreement which his "strike" brought him, and not broken it, as the Court determined he did.

At the time this conversation took place Mr. Martin said the reason he wanted to go into business for himself was because he didn't see that there was any chance of a copartnership. I refused to form a copartnership. When I concluded to organize a corporation the question as to how Mr. Martin should hold stock was discussed between us, and all arranged. Mr. Martin's salary, prior to the establishment of the corporation, was $50 a week. The year before he was given a bonus of $500 in addition. When the corporation was organized he was paid a salary of $2,500 a year under the agreement.

Q. After Mr. Martin took the editorship of The Electrical World after the organization of the corporation, when did the first trouble arise between you and him? A. I think it was in May, 1889.

Mr. Martin himself has testified that there was no trouble between him and Mr. Johnston at the time the company was organized or at any time before that date. It all arose after Mr. Martin became "a stockholder," and the "vice-president of the W. J. Johnston Company, Limited," "vested with all powers in the absence of the president."

Immediately before the 8th of February, 1890, the relations between Mr. Martin and me were not very friendly. Mr. Martin would not recognize me in going through the office. He was not in the habit of speaking to me. I afterward received complaints that he refused to talk with other employees on the business of the office. At that time, or immediately after, Mr. Stump complained to me that Mr. Martin refused to speak to him or transact business with him, because Mr. Stump had refused to vote in the way Mr. Martin had wanted him, in reference to censuring me or something at the board of directors' meeting.

Before this time Mr. Martin had made an arrangement on behalf of The Electrical World to have a stenographer take every word of the proceedings of the Convention. That arrangement was made by him before the meeting of the board of directors to which I refer. It had been arranged probably a week or ten days before the convention was held that the paper should be distributed at Kansas City. It was always an object of the paper to have it distributed at conventions, and regarded as important. Quite a number of advertisements were taken especially for the number that should be distributed and read at the convention. These two numbers of the paper were the most important during the entire six months. The revenue of the paper is derived principally from advertisements. It had been arranged that the paper should go on the special train which left Jersey City on Sunday morning, Feb. 9, at nine o'clock. Mr. Martin was aware of this. Notice of the departure of the train was published in The Electrical World in the issue of the previous week. Notices had been sent to each of our branch offices, one in Chicago, one in Philadelphia, and one in Boston, telling them that all matter for the issue of the 15th must be in not later than Thursday morning, Feb. 6.

I don't recollect having seen Mr. Martin at all on Feb. 8 until I saw him at about five o'clock that evening in the printing office. I didn't see him the previous day to speak to him. I can't say when I spoke to him before Feb. 8. During the whole of the week prior to Feb. 8 I was in the office, I think, and was within reach of Mr. Martin. During that week I heard of no complaints from Mr. Martin, or from any one else of any delay in the paper going to press. I heard no complaints of any matter having been withheld from him. I received no request from Mr. Martin or from any one on his behalf for any matter which he desired to use in the issue of the paper. I received no telephone messages from him on Feb. 8. Mr. Colvin did not even intimate to me that any messages had been received from Mr. Martin on Feb. 8.

Mr. Colvin, in his testimony, did not say he communicated to Mr. Johnston the messages which it was claimed he received from Mr. Martin; and he referred to only one or two messages.

Martin himself admitted he got the mail on this day at about 12 o'clock. Colvin swore that it was never delivered to him before 11 or 12 o'clock. As to this particular day, Colvin said he could not remember when he delivered it to Mr. Martin. This answer was not satisfactory to Martin's counsel, and then he asked Colvin this suggestive question: "If you had handed it to them earlier on that day you would have been apt to remember it, would you not?" And Colvin answered, "Oh, yes."

If we take this testimony as true, wherein was the delay?

It shows that Mr. Martin got the mail as early on this occasion as ever he got it on any other occasion.

A thing done at the regular daily time, fixed by custom or practice, cannot be said to have been delayed.

If getting it at the regular hour caused him delay, as Mr. Martin tried to show it did, then what Martin really needed to have claimed was that he wanted it, not at the regular daily time of delivery to him, but before the regular time.

In that case the duty would have rested upon him to notify Mr. Johnston on Friday to have the mail in his hands early on Saturday.

This he did not do, nor is it claimed that he attempted to do it. Probably, to meet this dilemma, he himself said he went to the office as early as 9:30 to see Colvin, but unfortunately for him Colvin failed to refer to this visit at all. Probably that matter was not quite so important in Martin's mind at the time Colvin was testifying, and when Mr. Martin was relying solely, and, as he trusted, securely, on Colvin's evidence and the letter of June 7.

On Feb. 8 I received no request from Mr. Martin for any instructions as to issuing the paper or how to issue it. I went over to the printing office that evening sometime between four and five o'clock. Prior to going there Mr. Kornfeld told me there was delay in issuing the paper. He told me this about 4:30 in the afternoon. He told me that Mr. Martin and Mr. Wetzler, he thought, were deliberately delaying getting the paper to press. Prior to what Kornfeld told me I had absolutely no knowledge or information that there was going to be any delay. I was in the office of The Electrical World until about one oclock in the afternoon. I then went to the theatre. My wife had company, and I had arranged to accompany them to the theatre. On the day of publication it was not usual in recent years for me to be on hand at the printing office. Mr. Martin had charge of putting the paper to press. I don't think that I had been at the printer's office on the day the paper went to press at any time for years prior to this 8th of February. I depended entirely upon Mr. Martin and Mr. Wetzler to get the paper to press.

Q. Mr. Colvin said here, and Mr. Martin referred to the same thing, that you withheld the mail matter from Mr. Martin on the 8th of February. I ask you now if it is true that you withheld the mail matter from Mr. Martin, or if it was withheld by your instruction?

Objected to as to form, and also on the ground that this matter was not brought out in the plaintiff's case. Objection overruled.

A. Neither then nor at any other time have I ever withheld from Mr. Martin editorial matter, or directed that it should be withheld.

Q. Have you withheld, or directed that there should be withheld, any mail matter which was properly belonging to his department? A. I never have, to my knowledge.

Q. Mr. Colvin said here, in answer to Mr. Masten's question, that the whole mail matter was first given to a lady clerk in the office by your instructions, and was afterward handed to Mr. Colvin to be handed over to you, and you withheld it for some time. Is it true? A. That is not true.

Q. What mail matter was handed to the lady clerk referred to? A. All the mail matter that came in was opened by her, and then it was turned over in bulk to Mr. Colvin. Mr. Colvin sorted the editorial matter and delivered it to the editorial department without letting me see it, unless something that was very much out of the ordinary. The object of handing this mail matter to the lady clerk referred to was simply that she could take the money out of the letters. When I went to Mr. Atkin's office on Feb. 8 I reached there about a quarter before five. I saw there Mr. Newman, the foreman, and Mr. Martin. I said to Mr. Newman: "What is the matter with the reading forms this week? Why is there so much delay?" He said: "We have not yet received any editorial copy." I said to Mr. Martin: "Have you turned in your editorial copy yet?" He said: "No." I asked him for a reason, and he said he didn't have time.

Q. At this time was there any complaint made by Mr. Martin to you of anybody having withheld from him any mail matter, or anything like that? A. None whatever.

Q. This was a few minutes before five o'clock, I understand you to say? A. Yes.

Q. How long did Mr. Martin remain there after you reached there? A. Not more than 15 minutes.

Q. During the time that you remained there did you in any way interfere with Mr. Martin in the discharge of his duties? A. Absolutely in no manner whatever.

Q. Did you take the management of the make-up of the paper out of his hands? A. No, sir.

If Mr. Martin was not contradicted by half a dozen witnesses as to what he swore to about Mr. Johnston interfering with him, the improbability of his story would of itself refute what he said:

"Probability," says Locke, "is likeliness to be true."

Taking the facts of this matter as Mr. Martin has been compelled to admit them to be, the probabilities bear no likeliness whatever to the truth of his story.

He swore that he knew it was both necessary and important to get the paper issued that night—that Mr. Johnston wanted it so; that it had been arranged to send the paper to Kansas City on the train which left New York at 9 o'clock the following Sunday morning; and that all this had to be done to comply with contracts made with the advertising patrons of the paper. Yet he expected to be believed on his unsupported oath that Mr. Johnston came at the eleventh hour and captiously prevented all these arrangements being carried

out; and when he succeeded in that—by driving Mr. Martin out of the printing office—then from mere caprice, as it were, he turned around and worked himself and others for about five hours that night, trying to accomplish what he just prevented Mr. Martin from doing.

No, there is not the faintest color of probability about this part of Mr. Martin's story.

Q. Did he ask you for any instructions as to issuing the paper? A. None whatever.

Q. Can you state now all the conversation which occurred between him and you? A. What I have said was the entire conversation. Mr. Martin was exceedingly gruff and short. A little later he put on his coat.

Q. What time was this? A. That was probably about five minutes past five. I looked at him in astonishment, and said: "Are you not going to stay and get the paper out to-night?" He replied: "We work regular hours now, and if you make inquiries you will find that printing offices generally close at five o'clock on Saturday, and I am going home." That was, I think, the only conversation we had.

Q. When he made the reply was Mr. Wetzler there? A. He was.

Q. How close to him? A. My impression is quite close.

Q. What did you do immediately after Mr. Martin told you that he worked regular hours? A. As soon as he said that he walked down stairs, and then I took off my overcoat and got the paper to press.

Q. What did you find was the state of the paper when you went to work at it? A. I found it in rather a chaotic condition. Some articles were completed, and some pages not completed. To a man who had not kept the run of all the matter it was exceedingly difficult to put the paper to press promptly. There were some illustrations without captions under them, and, of course, it was almost impossible without reading the whole article and knowing what the contents were to be able to distinguish the particular cut from the number that were before you—a dozen or so. I found it necessary, so as to avoid mistakes, to cut out four papes; that is to say, there were intended to be 20 reading pages, but to get the paper to press that night we had to cut the number down to 16. I wrote any of the captions to go under the cuts that I could write; and those regarding which we were in doubt we had to omit. In fact, we simply did the best we could under the circumstances.

Q. Were you able to find any editorial notes, or editorials for the issue? A. I was not.

Q. When Mr. Martin left there did he ask you before he went away whether you intended to put the paper to press? A. He did not.

Q. So far as you know, then, he left there, and he didn't know whether the paper would go to press or not? A. So for as I knew, he couldn't tell whether the paper would go to press or not.

Q. How long were you at work there? A. Till about nine o'clock, I think.

Q. How many men were at work there? A. Five or six.

Q. And they were all working till about nine or ten o'clock? A. Some of them, I think, later than that.

Q. You succeeded in putting the paper to press before you left there, did you? A. It was in condition so that I knew it was all right. I left for Kansas City the following morning, I think at about a quarter before ten. Mr. Stump went with me all the way to Kansas City. Mr. Colvin and Mr. Hunt went as far as Philadelphia. I had a conversation with Colvin about the occurrence of the evening before in regard to Mr. Martin. Mr. Colvin said that he expected different conduct from Mr. Martin; that, in his opinion, two wrongs would not make a right, and that there was no possible justification that he could see for Mr. Martin deserting his post at such a critical time without giving any warning. He said: "Had I been in Mr. Martin's place, and had I not liked you personally, or had I not liked the company, I would have come to you and said: 'I don't want to work here any longer,' but I wouldn't have tried to destroy a man's property. By this he referred to the evening before when Mr. Martin failed to get out the issue of the paper which he was paid for getting out.

The fact that Mr. Colvin entertained at this time just such an opinion of Mr. Martin's actions as Mr. Johnston says he expressed to him is well supported by what he wrote to Mr. Martin the following Monday morning: "Mr. Johnston, I know, would like the paper remade up . . . I hope you will go ahead and get the paper out in its usual form."

Had he then believed that Mr. Martin's conduct or course on the previous Saturday night had not been out of the ordinary run of things he never would have written "*I hope you will go ahead and get the paper out in its usual form.*" There was nothing certain about it in his mind that Mr. Martin would do so; it was with him entirely a hope that Mr. Martin would do his duty.

It has been the custom of the paper for many years to have those editorial notes in it. The convention at Kansas City opened at 11 o'clock on Tuesday morning. When I returned from Kansas City the first interview I had with Mr. Martin was when he came into my office on Monday morning, Feb. 17. Mr. Frank Knight was in the room at the time. Mr. Martin said: "I knew you would be unable to prepare the report of the Kansas City convention. I knew that you would get it all muddled up, and you have done so; and it is impossible for anybody to make head or tail of it. Of course, we will do as well as we can; we'll get the paper out as soon as we can, but just when the paper will go to press I can't say." As a matter of fact, I didn't have anything whatever to do with the report, except to go over it and correct some errors in the names, and to elaborate some points that I thought ought to be elaborated, or to cut down some that I thought ought to be cut down. This report was made up by the association of papers, and Mr. Martin had arranged for it on behalf of The Electrical World. It was precisely the same as was furnished the other papers.

Q. Did any scene occur between you and Mr. Martin in the presence of Mr. Knight on that day, the 17th of February? A. Yes. Mr. Martin turned around to Mr. Knight and said, as if addressing me: "I don't think I have been introduced to this gentleman, but if he comes to take a position in this office, I want to warn him that Mr. Johnston will take advantage of him as he has taken advantage of me."

Plaintiff counsel moves to strike out his answer. Motion denied.

When I came back to New York I gave instructions to Mr. Martin to get the paper to press as quickly as he could. I went to his room to find out how he was getting along. I found him working there very slowly. In answer to my inquiry as to when the matter would be ready for the printer he said he could not tell. The matter was very much behind, and it had not reached him until that morning. He was doing his utmost, he said. The report of Tuesday's proceedings was mailed on Tuesday afternoon or evening. That should have reached New York on Thursday. I mailed Tuesday's report on Tuesday; Wednesday's report on Wednesday; Thursday's report on Thursday. A letter leaving Kansas City on Tuesday will get to New York on Thursday. When I returned to New York I found that not only had no editorial notes been written regarding matters which might have been attended to during the week while we were gone, but very little that I had sent forward was in the printer's hands.

To the Referee: A letter mailed at Kansas City on Tuesday afternoon would reach New York on Thursday afternoon about four o'clock. It is about 48 hours mail travel from Kansas City to New York. The first portion of the report which I mailed at Kansas City would arrive in New York on Thursday afternoon. It would not reach the office until the next morning.

From Thursday afternoon until Monday morning Mr. Martin had not done much work. Most of the matter for the next issue containing the report of the convention was in the form of printed papers that would be read at the convention. An editor can just as well make his comments on such papers after reading them as he can in Kansas City where the papers are read.

Q. Did you ask Mr. Martin anything about the editorials on your return from Kansas City? A. I don't think I did. I would like to explain that for years before it had not been my custom to speak to Mr. Martin about his work. It was not necessary. Mr. Martin was a very capable man, and able to run the editorial department better than I, and I allowed him to run it. For years I had not given him instructions, except generally. If a certain matter seemed to me to be a good thing I gave him a suggestion, but never an absolute order.

Q. When you went to his room on Monday afternoon, the 17th of February, and asked him about the progress he had made to prepare the issue for the 22d of February, what did he say to you in reference to what you asked? A. He said he was working as hard as he possibly could, and that he didn't wish me coming in there acting like a hen with its head cut off, in my efforts to get the paper to press.

Q. Did you find out then as to how much of the report had been edited? A. I found out, as I say, that comparatively little had been edited; in other words, that a great deal that it seemed to me ought to have been edited was on Mr. Martin's desk, and he was making no special effort to get it to the printers. From what I saw in Mr. Martin's room on the morning of the 17th of February, it would not be possible to put the paper to press on that day the way that he and Mr. Wetzler were working. I offered my services if there was anything I could do to help the matter along, but my offer was not accepted. Going back a little later, about noontime, I found Mr. Martin and Mr. Wetzler both going out. They had put all the matter in their desks and locked it up. I asked them in astonishment whether we could not send some more matter to the printer; I pointed out that the delay was very injurious to us, but they said they had to have luncheon. I said: "If you will give me the matter I will look over it while you are gone." They said: "Will you take all the responsibility?" I replied that I would and I then prepared the matter and put it in the printers' hands After that Mr. Martin did not have anything further to do on the issue of the 22d, except to write an editorial or two. He did not write all the editorials for the issue of the 22d. I wrote some; Mr. Knight, I think, wrote some, and another employee of the office wrote some.

Q. Now, coming down to the 5th of March, I wish you would tell just what occurred in the office on that day between you and Mr. Martin?

Plaintiff objects to the question as not specific.

A. On the 5th of March Mr. Wetzler had a bookkeeper making an examination of the books. This bookkeeper came to my office to talk with me about something. While we were so engaged Mr. Wetzler came to my room, and we all three came out to the business office. Mr. Martin came from his own room in the editorial department into the business office and joined in the conversation there.

Q. (Counsel interposing.) Just allow me to direct your attention to some things: At that time when Mr. Martin appeared on the scene was there any dispute between you and Mr. Wetzler? A. There was; there was a heated conversation going on.

Q. Now, go on. A. Mr. Martin came out and joined in the conversation, and took Mr. Wetzler's part. I said: "Mr. Martin, this is not your place here; you belong to the editorial department. I want you to go to your own room and leave this office." He simply laughed and sneered, and said: "You can't order a partner about," and refused to obey my instructions.

Q. After you had ordered him to go to his room, how long did you wait there? A. I waited probably five or six minutes. I called Mr. Stump and others to witness the disturbance.

Q. And during the time you remained there Mr. Martin was still in the outer office? A. He was still in the outer office.

Q. And he didn't comply with the request that you made for him to leave and go to his own room? A. No, sir.

Q. Now, prior to that had Mr. Martin made an examination of the books on his own behalf? A. No.

Q. That examination which was being made there that morning was made on behalf of Mr. Wetzler? A. Yes

Q. Had you given Mr. Martin any permission to come out there and assist Mr. Wetzler in any way in making an examination? A. No, sir.

Q. Now, on that afternoon, I understand you handed him a discharge, or Mr. Colvin handed it to him? A. Yes.

Q. Did you have any conversation with him between that incident in the morning and that evening at the time you left the office? A. None whatever that I remember.

Q. What occurred the following day? A. The following day, I think, Mr. Martin remained in the office.

Q. You mean he came to the office? A. He came to the office, and it was understood that he was packing his things up, and would leave during the day. He didn't do so, however, and he came the next morning.

Q. He came first on the 6th and then on the 7th? A. Yes.

Q. What occurred on the 7th? A. On the 7th I went into his room and said: "Mr. Martin, it is not right for you to remain in this office after you have been discharged. If you have any case bring a suit for breach of contract; but I have discharged you, and you might as well go. I have a legal right to put you out of this office, even to call a policeman, if necessary."

Q. Did Mr. Martin say anything about having the advice of lawyers and being advised to remain there? A. He did. He said he had submitted this whole matter to his lawyer, and his lawyer had told him he could not be discharged. In reply to that I said: "Mr. Martin, I have gone to considerable trouble to get at the facts in this particular case, and I now assure you that under no circumstances can you remain in this office after I have discharged you. If you will go to my room I will show it to you in two minutes, and the whole matter will be settled right then and there. He simply replied: "I don't want to be shown."

Q. After he told you that he had legal advice that you could not remove him, what did you say about a policeman? A. I said: "Mr. Martin, I have a legal right to have you ejected from these premises as a trespasser; and if necessary I have a right to have a policeman remove you from here. Of course, I don't wish to do anything of that kind."

Q. After that did he tender his services to you, or was it before that he tendered his services? A. He tendered his services after that, after consulting his lawyer.

Q. After he tendered his services, what did he say? I mean did he say he was advised to tender his services? A. He did, if I remember correctlw. I said: "That's all right; that's all you can do."

Q. When did he finally leave? A. On the 7th.

Q. He was paid his salary in full? A. He was.

Q. Up to that date? A. Up to that date.

Q. The paper which has been marked in evidence is the notice discharging Mr. Martin, and which was given him on the 5th of March, is it not? A. It is.

On the 5th of March when Mr. Martin was discharged Mr. Knight was in Chicago. He was trying to close negotiations with Dr. Bell. These negotiations were commenced about Feb. 10. Up to Saturday, Feb. 8, I had confidence in Mr. Martin, but owing to the manner in which he deserted his post on that Saturday I lost confidence in him and determined to fill his place as quickly as I could. On the following Monday I saw Dr. Bell in Chicago. On the Saturday following I saw him again by appointment, and we talked the matter over very thoroughly, and left it in such a way that I thought Dr. Bell would come on. Some other matters in which he was engaged, however, were quite promising about that time, and I had to send Mr. Knight out to close the matter up. It was finally closed after Mr. Knight left there. Referring to the paper of Feb. 15, it was intended to be a 20-page paper. When I issued it it was only a 16-page paper. I could not put the other four pages in shape in Mr. Martin's absence. It is usual to have the paper distributed at the convention of larger size than the ordinary issue. The paper which I issued was the size of our usual issue, so that our intention to have it of larger size was not carried out.

I have a dispatch which was sent from Kansas City which notified Mr. Martin of the fact that the report had been forwarded. The dispatch was as follows: "Tuesday's proceedings and other papers mailed last night, due New York 4 p. m. Thursday. To-day's proceedings complete mailed to-night, due New York 4 p. m. Friday. If possible please have everything carefully edited and in the printers' hands Friday night or early Saturday, also editorial comments, etc., written." This message is dated Wednesday evening, so that all Tuesday's proceedings were mailed on Tuesday, and were due in New York on Thursday.

On one corner of the dispatch are the initials of Mr. Martin in his own handwriting, and Mr. Colvin's initials are on the other corner.

It will be remembered that Mr. Martin swore that he never received anything from Mr. Johnston while he was in Kansas City. Why Mr. Martin should have put his initials on this dispatch, unless he had received and read it, is something which he did not explain; and, again, why, after having received and read this dispatch, and still receiving none of the report until Monday morning, as he says, he still failed to inquire about it and find out who was withholding it from him, is something also about which he did not volunteer any information.

Mr. Martin, we think, acted wisely in not attempting to explain these things; but the absence of explanation shows pretty clearly who was telling the truth on this occasion.

We confidently assert that there is not an editor but will agree with us that when Mr. Martin read this dispatch it became his duty, if he was really acting in the interest of his paper, to have found out who was withholding the report from him. This dispatch showed

him some one was doing so, if it was withheld—that is, if what he said was correct.

At the time I made the agreement with Mr. Martin upon which this suit was brought, he paid nothing for the 100 shares of stock he received. The stock was given to him in consideration of the agreement.

Mr. Martin was exceedingly offensive in his conduct toward me, and what you might call exceedingly independent. He never lost an opportunity of impressing upon me the transcendent importance of his own work on the paper, and how difficult it would be to fill his place. In fact, on one occasion he told me he didn't believe that Mr. Wetzler's place could be filled in this country, and he knew his could not.

Q. What I direct your attention to is: Was he in the habit of treating you with respect or otherwise? was he offensive or otherwise? A. He was very offensive and very impertinent.

Q. I asked you the other day, the last day you were here, and called your attention to it, about the scene that occurred between you and Mr. Martin in the presence of Mr. Knight, and you answered the question. Do you wish to make your answer any fuller to-day?

Objected to. Question allowed.

A. That was the Monday after I returned from the Kansas City convention.

Q. What was the day of the month? A. The 17th of February, 1890. Mr. Martin on the issue before that date failed in his duty in getting the paper to press, and I didn't care to trust him any longer with regard to the paper, unless I watched it very, very closely.

Mr. Masten: Confine your answer to the question.

I asked to have Mr. Martin come in my room, to find out how he was getting along with the issue that was to go to press or ought to have gone to press that day. As he came in, Mr. Knight sat at the same desk facing me. Mr. Martin said: "I don't know that I have the honor of this gentleman's acquaintance, but if he comes here to work for The Electrical World I warn him that Mr. Johnston has deceived me and will deceive him." Then Mr. Martin turned to me and said: "I knew you would muddle that report all up. I knew you were not capable of making a report."

Q. Did he say anything on that occasion, in the presence of any one, as to whether you were to be trusted or not? A. Yes; he said to Mr. Knight that I was not to be trusted.

This concludes Mr. Johnston's direct examination. Want of space compels us to stop here and defer the publication of his cross-examination until next issue.

When published, this cross-examination will be found much more interesting than his direct examination, as it will let in a great deal of light on some phases of Mr. Martin's objects and motives; but we shall not make any comments until we are able to give Mr. Martin the benefit of all his lawyer did for him by cross-examining Mr. Johnston.

Electricity in Brazil.

The following extract from a letter recently received from Mr. James Mitchell, the engineer and agent of the Thomson-Houston International Electric Company at Rio de Janeiro, has special interest at this time, when a revolution is taking place in Brazil: "It may interest you to know that the country is in a state of active revolution, and that shots are falling in this city at short intervals, dealing death and destruction on every hand. The electric cars which follow a route along the beach are frequently obliged to stop, on account of the danger of being hit by passing balls. A few days ago a shell came through the roof of one car, or rather a piece of it came through, the shell having previously exploded, and killed two passengers, one man and a woman. At night the authorities oblige the cars to run without lights while on the beach section in order not to expose any conspicuous mark for the rebels to shoot at. As you know, the revolting party is the navy, and they have possession of the entire war fleet, which was stationed here, and have complete control of the harbor. The Rio de Janeiro harbor is so large that the vessels are easily able to keep out of range of the artillery in the hands of the land forces. But the entrance to the bay is only a few hundred yards wide, and is protected by three forts which are loyal to the government. So the rebel vessels are unable to leave the harbor, and amuse themselves by standing off at great distances and shooting at the fortified places with their heavy guns.

"Electric searchlights are brought into frequent play and every fort and fortified place has been provided with one of some kind. They are usually operated by a portable engine and boiler and French 100-volt dynamos.

"We might add that the city of Piracicaba recently inaugurated its plant. The plant consists of two Thomson-Houston alternating dynamos of 35 kilowatts each. The motive power is furnished by two Rodney Hunt water wheels, turbines, under head of about 50 feet. The streets of the city are illuminated with incandescent lamps of 32 c. p., 235 being in use at the present time. The balance of power will be used for private lighting and for heating and cooking apparatus. Coal costs $45 per ton in Piracicaba, and the proprietor of the plant, Mr. Luiz V. de Souza Queiroz, expects to realize the full benefit of his installation by renting current for cooking apparatus. He has already received a large number of applications on the basis of 30 milreis, about $7, per month. The economy of power cuts but little figure in this case, as the Piracicaba River is capable of furnishing about 12,000 h. p. in a distance of only 200 yards. Unfortunately the city is a small one, having only seven or eight thousand people, and is unable to profit by this magnificent power to its fullest extent.

A New Method of Charging for Electric Supply from Central Stations.—II.

BY OTTO FRICK.

Before proceeding to find the expenses per kilowatt hour during the different periods, we first take from the diagrams the annual consumption during the different periods and the consumptions below the lines *a*, *b*, *c*. We find consumption below line *a*, 2,469,000 kilowatt hours; below *b*, 3,686,000; below *c*, 3,959,000; and consumption during (1), 1,258,000; (2), 1,487,000; (3), 1,214,000; total annual consumption, 3,959,000.

Cost of Production per Kilowatt Hour During (1).—The 1,258,000 kilowatt hours delivered during (1) have to be charged for at the same rate as in a plant with a maximum

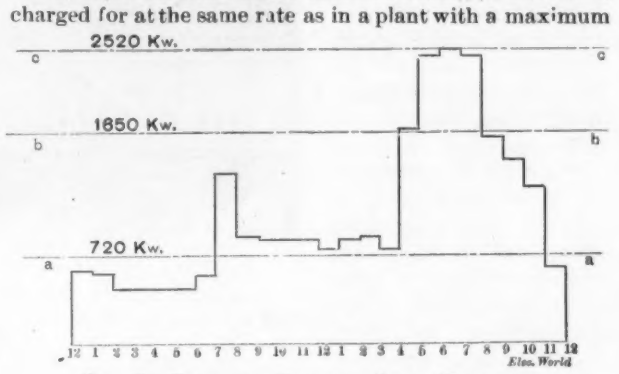


FIG. 5.—CENTRAL STATION LOAD DIAGRAM.

capacity of 700 kw. and an annual consumption of 2,469,000 kilowatt hours.

The annual expenses for interest and depreciation in such a plant would be, as above stated, $49,000,

$$\text{or } \frac{4,900,000}{2,469,000} = 1.984 \text{ cents per kilowatt hour.}$$

Expenses for management and attendance, $18,000,

$$\text{or } \frac{1,800,000}{2,469,000} = 0.729 \text{ cent per kilowatt hour.}$$

The expenses for coal and oil are calculated directly for (1) and equal 17,300 + 1,800 = $19,100

$$\text{or } \frac{1,910,000}{1,258,000} = 1.518 \text{ cents per kilowatt hour.}$$

The total cost of production would thus be

1.984 + 0.729 + 1.518 = 4.231 cents per kilowatt hour,

or with 10 per cent. for miscellaneous expenses.

1.1 × 4.231 = 4.654 cents per kilowatt hour.

Cost of Production During (2).—The 1,487,000 kilowatt hours delivered during (2) have to be charged as in a plant of 2,200 kw. maximum capacity and an annual consumption of 3,686,000 kilowatt hours, of which 1,258,000 kilowatt hours are charged after (1).

The expenses of interest and depreciation in such a plant would be $117,500 yearly.

To cover these, 1,258,000 kilowatt hours are charged at the rate of 1.984 cents per kilowatt hour, or $24,960.

The rest, $117,500 — $24,960 = $92,540 is to be divided by the remaining kilowatt-hours, 3,686,000 — 1,258,000 = 2,428,000 kilowatt-hours:

$$\frac{9,254,000}{2,428,000} = 3.811 \text{ cents per kilowatt-hour.}$$

Management and attendance have to be treated in the same way.

1,258,000 kilowatt hours, at 0.729 cent = $9,170.

The rest, $26,000 — $9,170 = $16,830 is divided by 2,428,000 kilowatt hours:

$$\frac{1,683,000}{2,428,000}, = 0.693 \text{ cents per kilowatt hour.}$$

The costs of coal and oil found as under (1) is $14,500 + $1,600 = $16,100 yearly,

$$\text{or } \frac{1,610,000}{1,487,000} = 1.083 \text{ cents per kilowatt hour.}$$

The total cost of production would thus be:

3.811 + 0.693 + 1.083 = 5.587 cents per kilowatt hour,

or, with 10 per cent for miscellaneous

1.1 × 5.587 = 6.146 cents per kilowatt hour.

Cost of Production During (3).—1,214,000 kilowatt hours are delivered during this time.

The expenses of interest and depreciation are, in a plant of 3,300 kw. maximum capacity, $160,000.

To cover these, 1,258,000 kilowatt hours are charged after (1)

1.984 cents per kilowatt hour = $24,960 yearly.

1,487,000 kilowatt hours are charged after (2).

3.811 cents per kilowatt hour = $56,670 yearly.

The rest, $160,000 — $24,960 — $56,670 = $78,370 yearly, has to be divided by the remaining 1,214,000 kilowatt hours.

$$\frac{7,837,000}{1,214,000} = 6.455 \text{ cents per kilowatt hour.}$$

Management and attendance: 1,258,000 kilowatt hours pay 0.729 cent = $9,170; 1,487,000 kilowatt hours pay 0.693 cent = $10,300. The rest, $32,500, $9,170, $10,300, $13,030, is divided by 1,214,000 kilowatt hours.

$$\therefore \frac{1,303,000}{1,214,000} = 1.073 \text{ cents per kilowatt hour.}$$

Coal and oil, $11,000 + $1,100 = $12,100 yearly.

$$\frac{1,210,000}{1,214,000} = 0.997 \text{ cent per kilowatt hour.}$$

The total cost of production per kilowatt hour during (3) would thus be

6.455 + 1.073 + 0.997 = 8.525 cents per kilowatt hour,

or with 10 per cent. for miscellaneous.

1.1 × 8.525 = 9.378 cents per kilowatt hour.

Summing the above results, we find the tariff (1) to be applied during 20 × 92 + 18 × 181 + 13 × 92 = 6,294 hours = 4.654 cents per kilowatt hour; the tariff (2) to be applied during 4 × 92 + 6 × 181 + 4 × 92 = 1,822 = 6.146 cents per kilowatt hour; the tariff (3) to be applied during 7 × 92 hours = 644 = 9.378 cents per kilowatt hour.

If the same tariff were applied over the whole year, the rate would be $= \frac{26,400,000}{3,959,000} = 6.668$ cents per kilowatt hour.

There is thus during 72 per cent. of the year a reduction of 30 per cent. in the price; during 20.5 per cent. of the year the price is about the same, and only during 7.5 per cent. of the year the price is increased 40 per cent. above the mean rate.

It is thus evident that this method of charging for the current offers indisputable advantages. On the one hand the higher charge during the afternoon hours in winter tends to reduce the load during these hours and thus increase the capacity of the plant, that is, allow a greater number of lamps to be installed with the same output of machinery. On the other hand it affords opportunity to use the current during day and night hours for purposes which before were excluded on account of the high price.

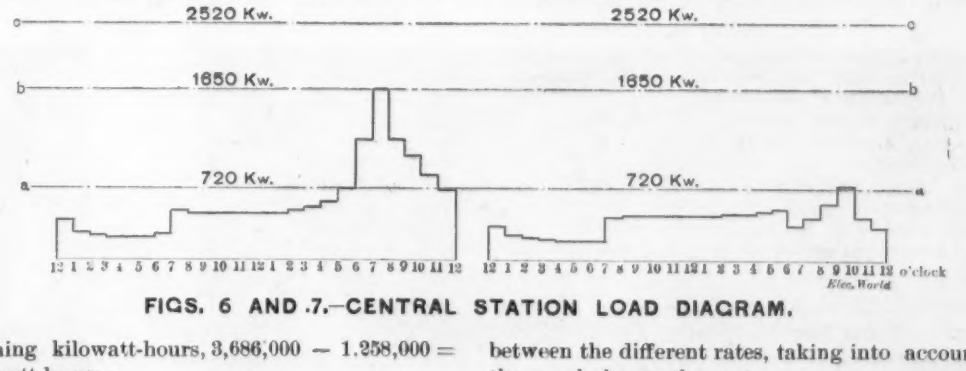
This new rate will, of course, have a tendency to alter the shape of the above diagrams, as it will sensibly raise the consumption during (1), and might have a slight reducing effect during (3).

If we assume that the consumption during (1) increases with 1,368,000 kilowatt-hours, giving the three average day load diagrams the shapes shown in the Figs 5, 6 and 7, the costs of production, calculated as above, will be for (1) 3.687 cents per kilowatt hour; for (2) 5.448 cents per kilowatt hour; for (3) 8.718 cents per kilowatt hour, thus showing a reduction of about 20 per cent. for (1), 11 per cent. for (2) and 7 per cent. for (3). If the first tariff be applied, the gain would be about $45,500, or 2.6 per cent. on the invested capital.

The figures given are of course not intended to directly suit any actual conditions, but might be very suggestive as to the way to get a tariff that permits the payment of high interest to shareholders, and at the same time affords the greatest possible advantages to the customers.

In practice it might be preferable to alter the proportion between the different rates, taking into account the value the supply has to the customer.

Certainly the objection that meters must be more complicated will be made to this tariff, but I do not see any reason why it should not be possible to any inventive mind to bring out a meter with these additional features that could be as simple as many of the meters that are now in use.



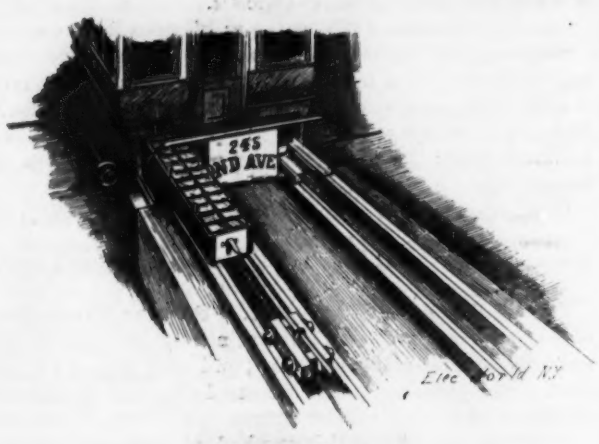
FIGS. 6 AND 7.—CENTRAL STATION LOAD DIAGRAM.

The Patent and Trade Mark Congress.

The proceedings of the recent patent and Trade Mark Congress at Chicago will be published in book form. About 40 papers were read, and among those who participated in the congress were Hon. Henry W. Blodgett, for 23 years Judge of the United States courts at Chicago; Hon John W. Noble, ex-Secretary of the Interior; Hon. Richard Pope, Canadian Commissioner of Patents; Hon. John S. Seymour, U. S. Commissioner of Patents; Hon. Benton J. Hall, ex-Commissioner of Patents; Hon. Benjamin Butterworth, ex-Cimmissioner of Patents; Hon. William F. Draper, Member of Congress from Massachusetts and of Patent Committee of House of Representatives; Hon. James Buchanan, ex-member of Congress from New Jersey and of Patent Committee of House of Representatives; Hon. Carroll D. Wright, U. S. Commissioner of Labor; Hon. W. Lloyd Wise, London, president Chartered Institute of Patent Agents; Judge Y. Sepulveda, Mexico, and many others well known in connection with industrial property, both in this country and abroad.

The Waddell-Entz Storage Battery Traction System.

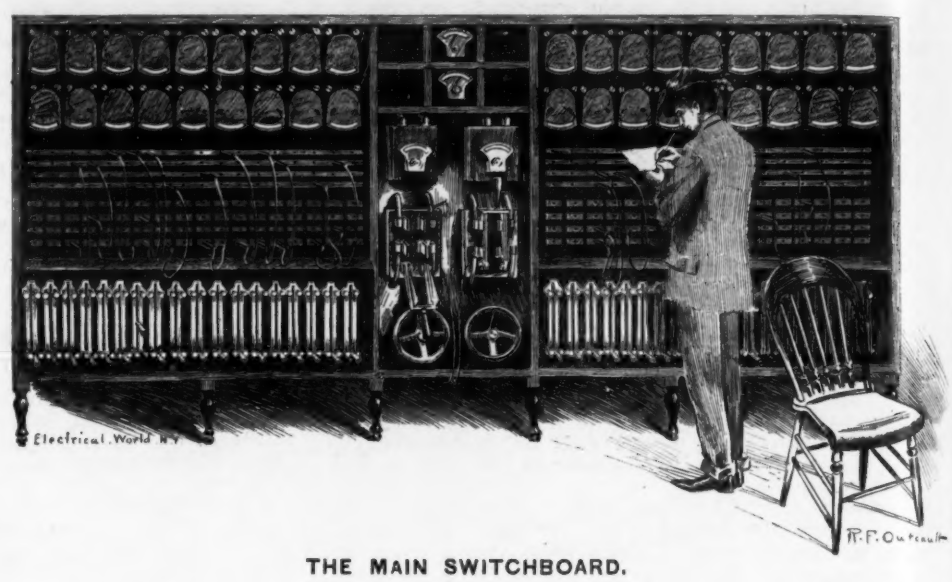
Some months ago we referred to what promised to be a very complete trial of the Waddell-Entz storage battery street railway traction system on the Second avenue line in New York City. We then ventured to predict that, on account of the admirably designed plant there installed and the unusual care given to details from an engineering and mechanical standpoint, the result would go a long way toward definitely settling the question of storage battery traction. In this issue we are enabled to give some of the data of the trial, from which it will be seen that the results have been very encouraging, and that, even on the comparatively small scale on which it has been conducted, the cost per car-mile compares favorably with some methods of street railway traction, and is cheaper than others. Even had the cost been considerably greater the advantages from increased speed and greater comfort of travel would have still rendered the results gratifying, and these factors should be given weight in considering the actual figures.



SHIFTING TABLE.

As stated in a former issue, the generating plant consists of two 100-h. p. Worthington boilers, two automatic Ideal 75-h. p. engines, to which are directly connected two 75-h. p. Waddell-Entz internal pole dynamos, a full description of which type will be found in The Electrical World of August 12, 1893.

The storage battery is of the well known zinc-copper alkaline type. As constructed by the Waddell-Entz company, the positive element consists of an agglomeration of finely divided copper held about a central copper wire by fine wire netting; to still further secure the finely divided copper in position an outside covering of cotten is woven around it, thus giving the finished product the appearance of insulated magnet wire. This wire, as we may call it, is then wound spirally to form a flat rectangular sheet of the thickness of the insulated wire. A number of these sheets or plates, usually seven, are then united together to form the positive side of the cell, and are placed in an iron case divided so that there is an iron partition between each of the positives. A solution of potash in which zinc has been dissolved forms the electrolyte. Upon charging the cell the zinc in the solution is deposited upon the sides and partitions of the case, and the copper of the wire is oxidized; in discharging, the battery may be considered a simple oxide of copper and zinc cell, the zinc being redissolved into the solution from the iron surfaces, and the copper oxide reduced. The size of the case is 4⅝ inches by 7½ inches by 11¾ inches high, and a complete cell weighs 29 pounds. The E. M. F. on open circuit is .89 volt, and the working E. M. F. is about .82 volt; the capacity of one of these cells is 350 ampere hours or 270 watt hours, and thus is equivalent to a 143 ampere hour lead cell. A very valuable property of this cell is that the E. M. F. remains constant at discharge until the cell is exhausted and is not elevated to any considerable extent during the charging; it will be recognized that this is in marked contrast to lead cells, particularly in respect to the latter point. To protect the solution from carbonization there is a covering of paraffine oil on the top of the electrolyte of each cell. During the charging it has been found advisable to to raise the temperature of the cell to from 45 to 50 degrees centigrade, as this reduces the internal resistance and at the same time through convection keeps the electrolyte in uniform condition. The heat is applied by means of steam coils, upon which the tray rests when charging.



THE MAIN SWITCHBOARD.

The cells are arranged on trays, there being 72 cells to each tray, and two trays to each car. Sixteen of the 144 cells are in a separate circuit for exciting the field magnets, and also for use on the car incandescent lamp circuit at night, thus giving a steady and uninterrupted light.

The arrangements for handling the cells are very complete. When a battery is to be changed, the car is run up to a platform and a door opened on each side of the end, as well as corresponding ones in the dashboard. A line is hooked to the two trays, which are on rollers, and an electric motor, connected to a drum shaft, then draws the trays on a platform or shifting table, where they are then hooked to a traveling crane, elevated to a room above and carried by the crane to their appropriate charging stands, where the electrical connections are made and recharging begins at once (see illustrations). This entire operation can be performed in four minutes with ease.

All of these operations are controlled by one man from a controller. The traveling crane is, of course, an electric one and receives its power from four trolley wires, one of which is a common return, another for the fields of the motors, a third for the armature of the traversing motor and a fourth for the armature of the hoisting motor. There are three motors altogether, one of 5 kw. for the travel of the crane, another of the same power for the hoist, and a third of 2 kw. for the traverse. The power for these is taken from a battery the same as used on the cars.

The switchboard, which we illustrate, is compact and well arranged. The central portion contains the apparatus for the two main dynamo circuits, and on each side are the battery charging circuits. The two upper bars conect with one dynamo, and the two lower with the second dynamo. Between each pair of plug plates in the upper row there is a resistance of about one ohm, which enables any resistance between 1 and 17 ohms to be inserted in a circuit for special purposes. The second and third rows are on the positive charging battery circuits and the lower row on the negative charging circuit. There are an ampere meter and rheostat for each battery circuit, the latter being of a special form, as shown at the foot of the board. Carpenter resistances are used throughout, and Western electric ammeters on the charging and Weston instruments on the main circuits.

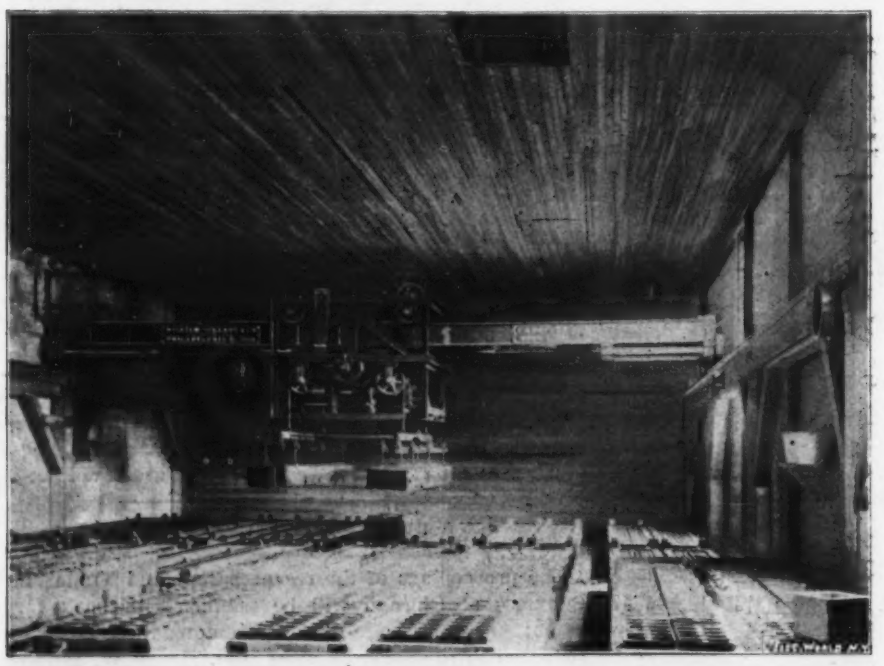
When a battery is plugged for charging, a card is placed on the ammeter of its circuit, upon which a record is made of the time and amount of charge, and it is then filed away. A record is also kept on an appropriate blank of each cell in a battery, all of which are regularly tested, so that the history of any cell may be gotten at a glance.

For each car there are two sets of batteries, or 288 cells in all. The cars run at the rate of from 11 to 12 miles an hour, and at this rate, including stoppages, the car is in service from two and one-half to three hours on one charge, making about 20 miles. The average discharge at normal speed is at the rate of from 40 to 45 amperes, and 20 ampere hours are charged for each round trip on the Second avenue line from Ninety-fourth to One Hundred and Twenty-ninth street.

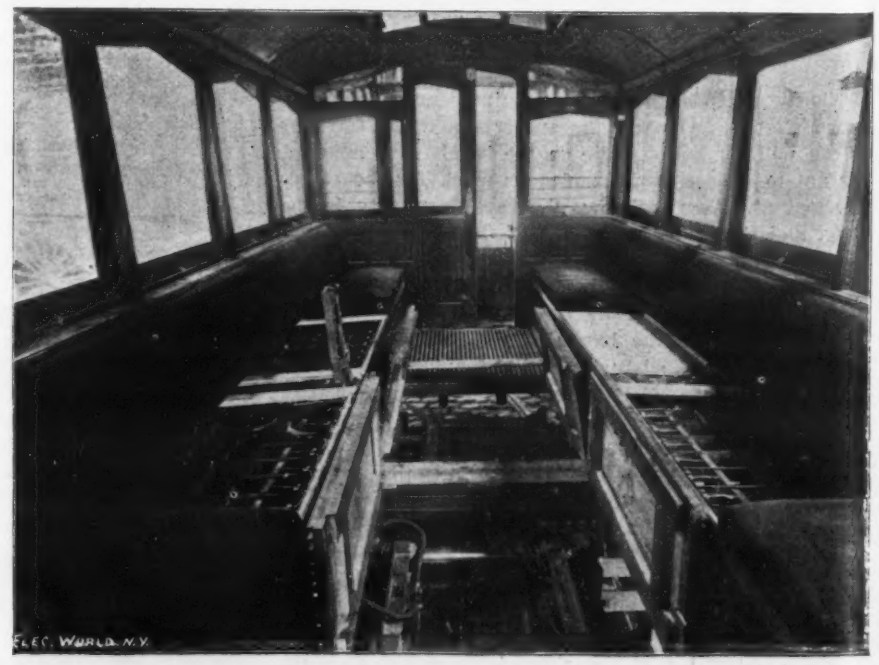
The car motors are of the same type as those described in our issue of August 12, 1893, and only differ in having a trunnion for the mounting, which we illustrate. The two motors are rated at 25 h. p. each, but only one is used at a time, ordinary street railway practice having been followed in the addition of the other motor.

The controller has seven points; when the pointer is at the zero mark, the current is off entirely; when on the first point the armature is short circuited on itself, and by means of this, on the reverse motion, the car can be stopped in a short distance by the braking action of the motor acting as a dynamo; when on the second point the cells are in multiple in four sections; when on the third point, two sections of the battery are in multiple and two in series; on the fourth point all of the cells are in series; on the next two points the fields are weakened, thus giving two further increases to the speed. In stopping the car the action is to reverse that just described and there is a reversing point beyond the zero. As will be seen, this gives a very thorough control of the speed, and in actual operation, as has been demonstrated by the lengthy trial, the cars are under admirable control, and can be stopped from full speed ahead in 25 feet.

The cars have been running continually since June 1, 1893, and had run over 40,000 car miles up to the 15th of October. Since Aug. 1 they have been running on five minutes headway from 6:55 a. m. to 6:15 p. m. each day, thus giving a mileage of 400 per day. Since the



TRAVELING CRANE.

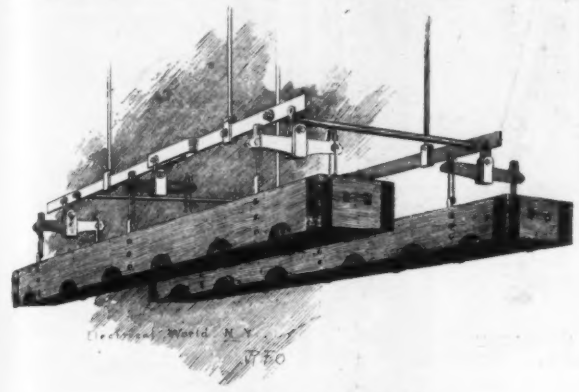


BATTERY CAR.

cars have been placed upon the line the traffic on the road has never for an instant been delayed, and not one half of one per cent. of the schedule trips missed.

Through the courtesy of the Waddell-Entz company we are permitted to publish herewith some valuable data in regard to operating expenses. A very carerul system of keeping account of these was devised and carefully carried out, in which the expenses for running are given under the following heads:

Operating force, which includes two engineers, at $18 per week each; two men at the switchboard at $15 and $16 per week each; one man to hook on at the



BATTERY TRAYS ON CRANE.

shifting table downstairs and one man for the same purpose on the battery floor, each at $9 per week, making a total of $85 per week for the operating force, or 3.54 cents per car mile for this item.

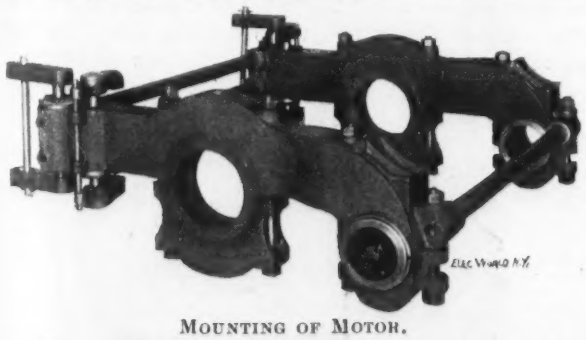
There are two battery men at $9 per week each to give the batteries what attention they need, making .75 cent per car mile; and two men on the repair shop force to repair damages to motors, gears, cars, etc., at $9 per week, or .75 cent per car mile. The coal for all power, including crane and shifting table, was weighed each day, and all the coal going into the boilers for all purposes averaged 15.8 tons per week, which, at $3.42, amounts to 2.24 cents per car mile; the oil, waste and water bills amounted to .2 cent per car mile. The depreciation of the batteries, including cost to replace damaged cells in as good shape as new ones, amounted to 1.54 cents per car mile.

These, we are informed, are actual figures taken from their books during the last three months, and give a total of 9.32 cents per car mile, divided as follows:

Operating force	3.54	cents	per	car-mile.
Battery men	.75	"	"	"
Repair shop force	.75	"	"	"
Fuel	2.75	"	"	"
Oil, waste and water	.20	"	"	"
Renewals, motor gears, etc.	.30	"	"	"
Depreciation of batteries	1.54	"	"	"
Total	9.32	"	"	"

The present battery shifting apparatus, including the crane and shifting tables, changes the batteries, as we have remarked before, in four minutes, but the present schedule allows a headway of 10 minutes between shifts. As each car runs three hours with one charge of batteries, 18 cars can be employed under 10 minutes headway between shifts.

The running expenses with a greater number of cars will, of course, be considerably less, and the following is given as a conservative estimate for running the present plant to its full capacity of 18 cars, running each 80 miles per day, or a total daily mileage of 1,440. This



MOUNTING OF MOTOR.

would require the operating force to be increased by three extra men, one each on the shifting table, crane and battery floor, thus increasing the present payroll by a third, or to 1.30 cents per car mile. Estimating the fuel on a basis of an evaporation of 30 pounds of water per indicated horse power hour with boilers of the same efficiency as at present, and with a saving of 16⅔ per cent. through the greater number of cars and longer hours, this item becomes 1.15 cents, and the total operating expenses as follows:

Operating force	1.31	cents
Battery men, double present force	.42	"
Repair shop force, double present force	.42	"
Fuel	1.15	"
Oil, waste and water	.15	"
Renewals, motor gears, etc.	.30	"
Depreciation of batteries	1.54	"
Total	5.29	"

Making a total of 5.29 cents per car mile on this basis. The only reductions figured from the present expenses are in the proportionately smaller payroll for a larger number of cars running, and in the improved efficiency of the engines at 30 pounds of water, which is certainly a fair figure to estimate on. All repairs and depreciation of batteries, motor gears, etc., have been taken the same as at present.

As soon as certain work connected with the laying of water mains in Second avenue is completed and the roadbed put in shape, battery cars will begin to run below Ninety-fourth street.

Laboratory Notes.—VIII.

BY LIEUT. F. JARVIS PATTEN.

Such a machine will also be found to have two field windings, a fine one, *f f*, Fig. 10, and a coarse one, *F F*. Operated on a direct current to get alternating currents, the fine-wire field is connected preferably in shunt to the motor brushes b_1 b_2, and these are connected to the 110-volt mains; or this field, with a small resistance in circuit, may be independently connected to the 110-volt mains. Used this way to generate alternating currents, the large field winding is left open. The machine will have a practically constant speed with the fine-wire field alone in shunt to the armature. Suppose now you have a 10-ampere arc light circuit as the only available source of energy at your shop. This machine will answer well, for now you have simply to disconnect the four coils of the fine-wire field, which you will find all connected in series, and this as a shunt to the armature circuit, taking about 2½ amperes. Connect them all four in parallel, when they will carry the 10 amperes of the arc circuit without undue heating, and in this shape they must be connected to the armature circuit in series, and you have an arc circuit motor dynamo. The machine in this form will tend to race, there being no governor or regulator, but you have one at hand in the shape of the course field winding; by putting current through this in a suitable way you can control the speed.

The mechanical construction of this type of machine lends itself admirably to this change of form. Thus you will find its commutator is on a hub at the extreme end of the shaft outside the bearing, as shown in Fig. 11. The armature connections run out through the spindle, which is hollow at one end, and return to

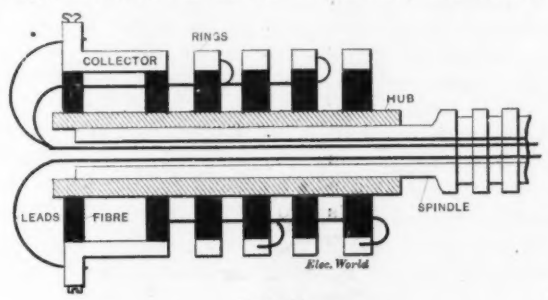


FIG. 11.

the commutator, which is carried on a wooden hub driven on over the spindle. You have simply to remove this hub and replace it by one long enough to carry the eight-part commutator, which need not be over three and a half inches long. The four rings need not be more than three-quarters of an inch wide each and spaced one-half an inch apart.

Larger forms of these Brush machines have 12 armature coils. These present no particular advantage over the other kind except the facility they offer for connecting up either three points of the armature winding to three rings for triphase currents, or four points to four rings for biphase currents, or both systems may, if desired, be arranged in the same machine at the same time.

The difference in the functions of this form of motor dynamo and that of the Edison type formerly described with two rings on the commutator should not be overlooked. The latter transforms the working armature current to an alternating current for an external circuit, whereas the Brush machine arranged as described is a true motor transformer, which, by mechanical work as a motor, generates an alternating current in a separate independent dynamo circuit, as if it were a double machine having two armatures on the same spindle.

A brief description of a general form of motor dynamo for single and multiphase currents, which may be used at the same time or separately and which machine the experimenter will find it a good bit of practical work to build for himself throughout, will conclude our consideration of this motor dynamo for laboratory use.

The machine will have a Gramme ring armature of the type formerly described, having 96 coils connected in three separate, independent circuits of 32 coils each in alternate series around the ring. Connect one of these windings to a 32-part collector as an ordinary Gramme ring circuit. This will be the motor or working circuit to which the 110-volt direct current is supplied. Connect four equidistant points of one of the remaining windings to four sliding ring contacts on the spindle at the opposite side from the collector. These will give single or biphase currents, as required. Connect three equidistant points of the remaining winding to three more sliding rings outside the last four, making seven rings in all on one side of the armature, from which a single alternating current or biphase and triphase alternating currents may be derived separately or together. This armature will be placed in a two-pole field, shunt wound in relation to the direct current armature circuit, causing it to run at a constant speed. This machine can be got up at a moderate cost and will answer as a sort of universal motor dynamo transformer for single and multiphase currents.

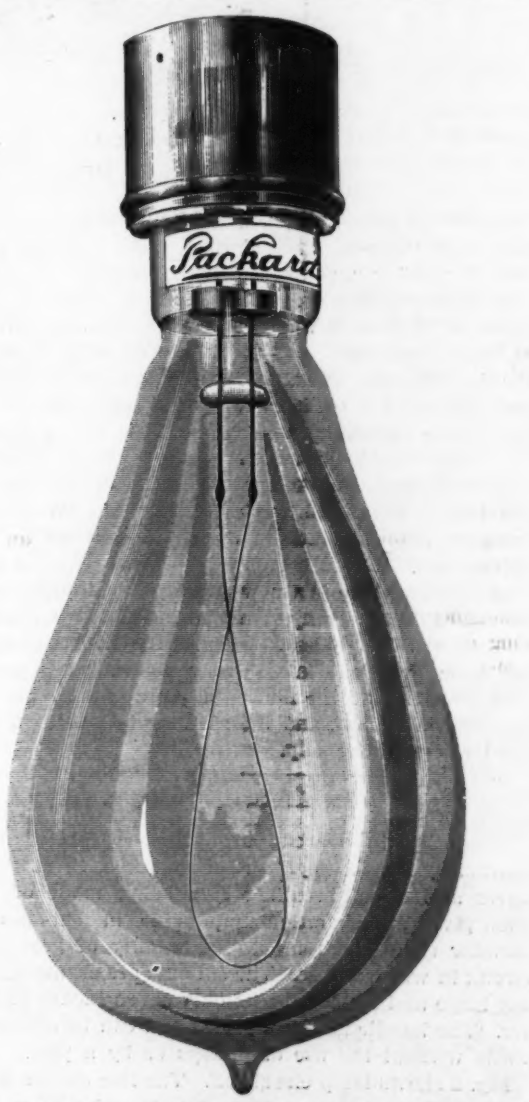
(To be continued.)

Large Incandescent Lamps.

During the comparative quiet of the past summer the New York & Ohio Company, Warren, O., have devoted attention to the development of some new ideas in incandescent lamps. Their latest improvement has been in the production of a lamp of exceedingly high candle power, and they are now making lamps of 200, 300 and 500 c. p., to burn singly on incandescent circuits of any voltage, and having a commercial efficiency of 2½ watts.

By the use of a superior carbon of large diameter and very low resistance, burned at high incandescence, the lamp has a very high efficiency. Its candle power is maintained at a maximum during the life of the lamp by the use of gas in the manufacture.

It has long been a favorite theme with lamp manufacturers to determine whether incandescent lamps of large units are to be preferred to series arc lamps. Because of the character of the light and the readiness with which the incandescent lamp lends itself to all kinds of service, the advantage is claimed to be in favor of the latter. These large candle power



A HIGH CANDLE POWER INCANDESCENT LAMP.

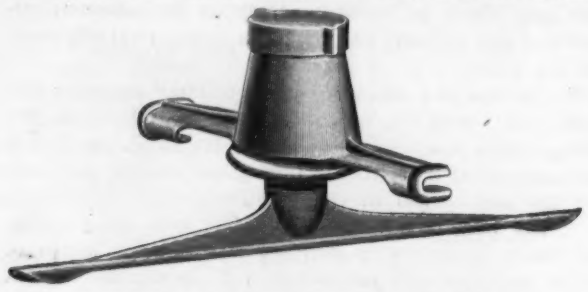
lamps are made in two classes; Class A, high efficiency; Class B, longer life. They can be made for any efficiency. When burned at the usual efficiency of incandescent lamps, their life exceeds that of the latter. For lighting large areas, it has been found economical to run them at the higher standard. The cost of the "Mogul" lamp of, say, 100 candle power, as compared to a group of small incandescent lamps of the same total power, is small, and the extra light obtained will, on the average, pay for the cost of lamp renewals after 150 hours of their life, it is claimed.

New Trolley Line Material.

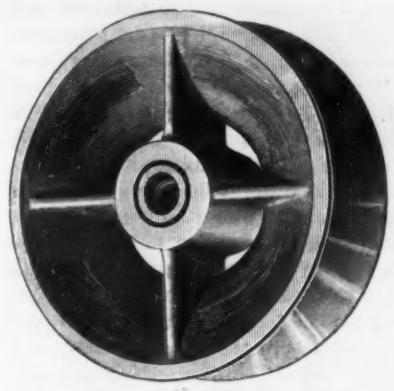
A conspicuous feature of the Street Railroad Convention was the fine display of the new railway line appliances which the General Electric Company has just perfected and brought out. They differ in some respects, not only from line appliances made by other manufacturers, but also to some extent from those hitherto associated with the name of the General Electric Company. The design of each piece betrays an especial care, as if every defect developed in appliances for similar purpose had been reviewed, and precaution taken to eliminate all chances of recurrence of the defects in the type adopted. The design of some of the appliances has been modified slightly, as will be seen on reference to the cuts.

These line appliances, known as Form "E," have already been installed on several roads, and their reliability has been tested and proved. The metallic parts are of

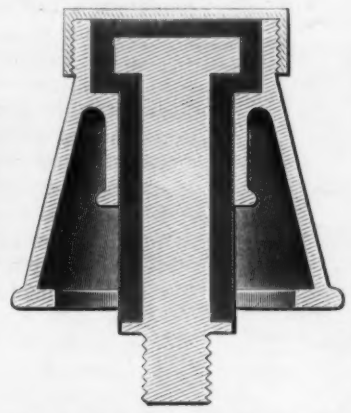
bronze. The insulation used is known as the "L" compound, and is hard, homogeneous and solid, having insulating qualities higher than those of any other material applied to this purpose. The part common to all suspension appliances is the bolt, which is also of bronze, and is covered with the "L" compound. All the suspension bodies are strong, durable, and are so constructed as to be very readily placed in position on the line. It will be seen that their construction is such as best to adapt them to the heavy strain and hard usage incidental to street railway practice. The bell portion (Fig. 1) is wide and deep, and affords thorough protection from both moisture and accident. In putting up this device the ear may be soldered to the wire, the bolt thrust



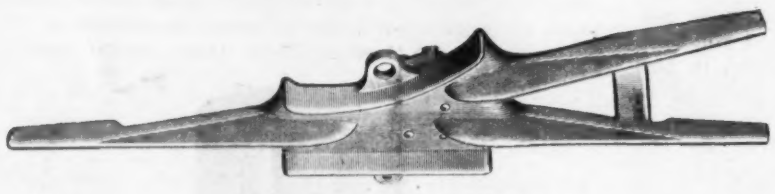
STRAIGHT LINE SUSPENSION, WITH EAR.



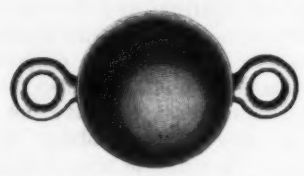
SPOKED TROLLEY WHEEL.



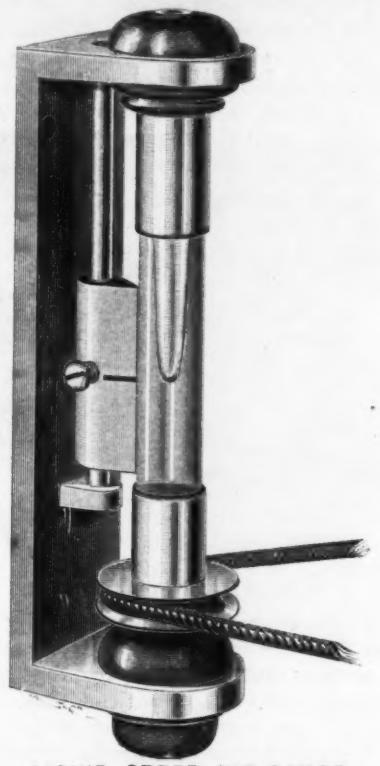
SECTIONAL CUT OF STRAIGHT LINE SUSPENSION.



RIGHT-HAND TROLLEY FROG.



SPHERICAL STRAIN INSULATOR, WITH EYES.



LIQUID SPEED INDICATOR.

NEW TROLLEY LINE MATERIAL.

through the suspension body and screwed into the ear, and then the cap screwed over the body and tightly locked, making a point that is water proof.

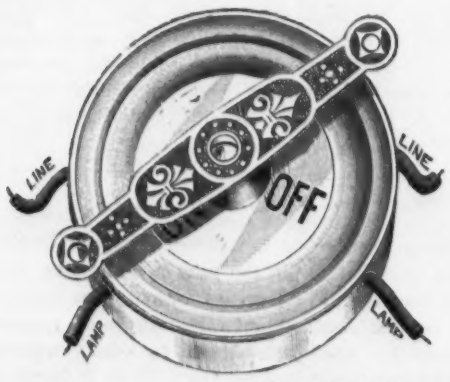
In the new trolley frogs the important feature is the disposition of the runways. That for the straight track is larger, and is placed somewhat in advance of that for the turn-out. The wheel is thus caught more quickly, and the chance of it running off lessened. The runways are straight, and are so made as to be on the same level as the trolley wire. They are furnished with projecting lips that can be bent over the trolley wire, and the appliances can thus be used without soldering until their definite position has been determined.

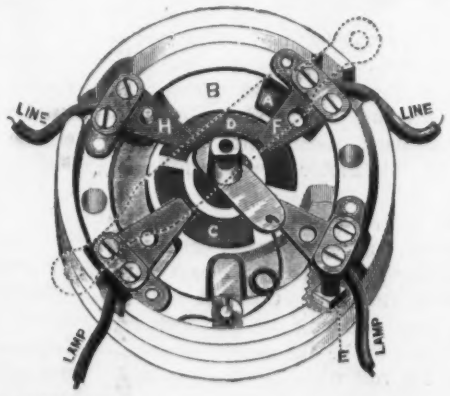
In addition there is a new patent spoked trolley wheel. The great difficulty experienced with some wheels, which become utterly useless as soon as the flanges give way, has been overcome in this new wheel. The spokes or ribs serve to hold the flanges in position after the wheel has been worn out, and the car may be run back to the car house without help.

An All-China Cut-Out.

A novelty in arc cut-outs has been placed on the market by Pass & Seymour, of Syracuse, N. Y., the case cover and circuit-breaking cam being made of china. This gives an insulation impossible in cut-outs with metallic cases and removes all liability of grounding a circuit in wet weather. The cut-outs are ornamental and not large and clumsy, being only seven inches in diameter. The handle is nickel plated and can be operated by cords without the use of pulleys or by a pole.

Fig. 2 shows lamp circuit off. The line circuit is made through contacts F and H, a plate D and a lever A. By through contacts F and H, a plate D and a lever A. By right, carrying the plates D and C with it, which pass between the contact F and lever A, breaking the line circuit and throwing the lamp in circuit. There is no arcing on plates C or D when the line circuit is broken, as D leaves H before B opens the circuit. The cam B is moved very quickly by means of the torsion spring on the handle post, and as it passes between A and F the arc is pushed out, as well as blown out, by the puff of air produced by the sudden motion of B. The plates C and D are held against the contacts by three spiral springs under each, and a perfect rubbing contact is made. The clamps for the line wires have two heavy screws in each, and also a nut and spiral spring as shown at E, Fig. 2, which insures perfect contact.



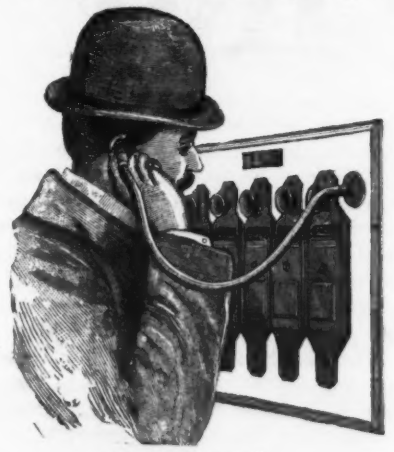


FIGS. 1 AND 2.—ARC CUT-OUT.

An "Eariphone."

The accompanying illustration represents a useful improvement in speaking tubes, manufactured by Frederick Schluchtner, 2661 Atlantic avenue, Brooklyn; the mouth piece is separate from the ear piece, whereby messages may be more conveniently received and transmitted. The name of "eariphone" has been given to the new apparatus.

The illustrations show the improvement in use in the hallway or vestibule of a house, but it may be employed in a factory, or elsewhere, where the different floors are held in communication with the office. The mouthpiece may be of the usual form, but the tube in front of the whistle has an opening at one side, surrounded by a tube leading into an attached flexible tube, at the end of which is an ear cup. The branch tube leading from the side opening in front of the mouthpiece leads backward at a slight angle from the main tube, and the branch tube is also made tapering, the flexible



"EARIPHONE."

tube being secured to its smaller end. When a person blows into the speaking tube, the air exerts its full force upon the whistle in the usual way, not being diverted into the branch tube. In like manner, in speaking into the tube, the voice is projected forward in the usual way; but one can likewise hear the return message without change of position, the voice in this case being diverted into the branch tube, and thence through the flexible tube to the ear cup, so that a conversation may be carried on without constantly changing the end of the tube from the mouth to the ear, and vice versa. A fork supports the ear cup when the mouth piece is not in use. This invention can be applied to any existing form of speaking tubes.

A Liquid Tachometer.

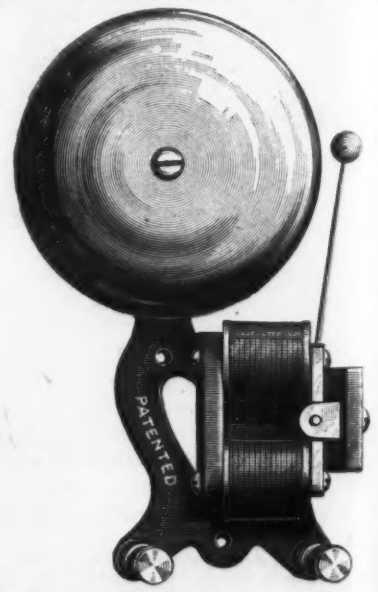
We illustrate an inexpensive speed indicator, based upon the well known law that the surface of a liquid in rotation assumes the form of a parabola, being acted upon horizontally by centrifugal force and vertically by gravity, which shows continuously the speed and variations of speed of any machine to which it may be connected.

One of these instruments, which is manufactured by Geo. T. McLaughlin & Co., 120 Fulton street, Boston, suitably connected to an engine (or other machine) will show whether the speed is up to the mark at a glance, the index being set to correspond to the normal number of revolutions per minute. The gauge gives the best results when driven at a high speed, when a small variation will make quite a difference in the indication.

Most tachometers have springs, levers and other mechanism, all of which are liable to get out of order, but this one has only the very simple parts necessary to bring it into action, and is based on fundamental physical laws, which cannot possibly change. It is especially adapted for connection to engines, dynamos, looms and all other machines requiring a regular speed, and is valuable wherever it is desirable to know at a glance whether normal speed is being maintained, or if there are irregularities due to improper setting of valves or other causes.

A New Magneto Bell System.

The Armature Bell Company, 216 High street, Newark, N. J., has recently placed on the market a bell under the name of the "Armature Bell," which entirely dispenses with the use of batteries, the current necessary to work the bell being generated at the push or pull when they are operated. Fig. 1 represents an armature bell call, which is adapted for hotel, private house, apartment, office or factory use. A half turn of the key either to the right or left will generate instantly current sufficient to ring the bell. The armature occupies a space about 1⅝ inches in diameter and about 1¾ inches in depth, and while being a substitute and doing away with the use of batteries can be attached to present wiring now in use without necessitating any rewiring. Another form is a straight pull door call, has the usual straight pull knob; a lever pull call is has the usual straight pull knob; a lever pull bell is also made worked on the same principle. In the different forms the act of turning the key, pulling the knob or depressing the lever, gives motion to an armature in a strong magnetic field, which generates the necessary current to operate a bell, shown in Fig. 2, which has been specially designed for use in this connection.

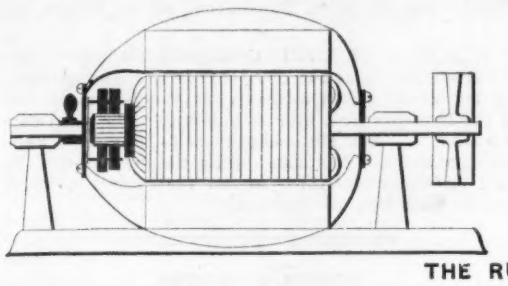


FIGS. 1 AND 2.—MAGNETO BELL SYSTEM.

A New Dynamo.

We illustrate a new dynamo recently designed by Mr. Charles Russell, of 18 South Broad street, Philadelphia, for which several special features are claimed. The machine, as will be seen, is an ironclad one, with no external magnetism, and can be cheaply constructed, from the fact that the frame is all cast in one piece, which also avoids joints in the magnetic circuit and the loss incident thereto. The cost is still further reduced by the very little machine work necessary, there being little even on the armature.

The spider to hold the armature is cast the requisite



THE RUSSELL DYNAMO.

shape and the discs are made out of sheet metal, with the necessary indentures for the spider and the armature wire. As the wires are laid in grooves in the armature, the latter can be brought into very close proximity to the pole pieces, thus reducing the magnetizing energy for the field.

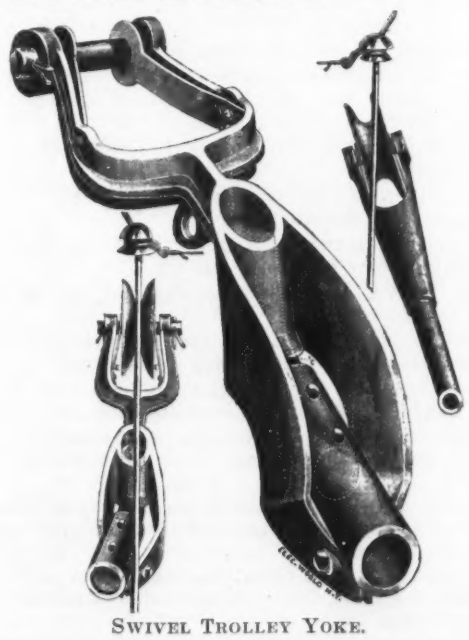
The machine is equally adapted for all classes of work, either incandescent, arc or power purposes, including motors of all types, and special advantages are claimed for its adaptability to electric street car work. The street car motor is a modification of the type illustrated; the fields are nearly flat, but the same principles are applied as in the regular type, with such modifications as are necessary to adapt the motors to the position which they occupy.

As will be seen from the illustration, the machine is in reality a four-pole one, but with magnet coils on only two poles; the armature is entirely inclosed.

The Swivel Trolley Yoke.

An improvement with merit in trolley devices that saves both time and money is always welcomed by the railroad trade. Such an improvement is claimed by Mr. James T. Fuller, bearing the name of the Standard swivel trolley yoke, and is manufactured by the Standard Railway Supply Company, 1117 Monadnock Block, Chicago.

The name implies that it swivels, and this is readily seen in the accompanying illustration. All those having any practical experience in railroad matters will appreciate this feature, as it prevents, to a great extent, the wheel from leaving the trolley wire.

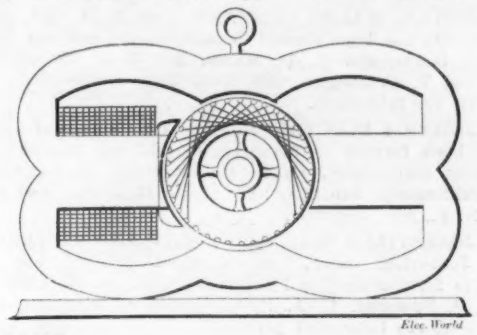


SWIVEL TROLLEY YOKE.

By their peculiar design, the downward wings limit the axial motion on the drop forged pin, which is riveted wheel from leaving the trolley wire, especially on curves and on switches.
in the pole. The bolt or pin passing through the wings under the pole prevents the yoke from being taken off with the axial pin. The wings also prevent the yoke from becoming entangled in the trolley or guard wires when the wheel is thrown off the wire. The contact springs are of a new design, and can be replaced with the greatest ease and despatch, with no possibility of losing the screws. The yoke is made to fit either the Edison or T. & H. standard wheels, and the drop forging the ordinary steel pole.

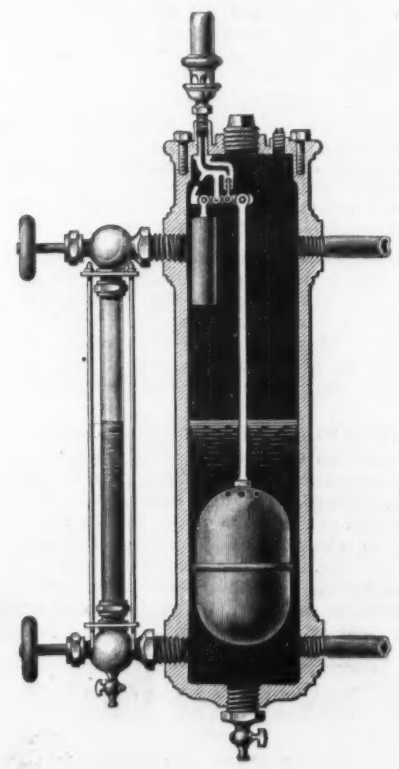
A Low Water Alarm.

The principle of the low water alarm we illustrate, which is manufactured by the Ashley Engineering Company, 136 Cortlandt street, New York, is based upon the difference in weight of a body suspended in air and immersed in water. The alarm has two connections to the boiler common to a water column, and is shown with all gauges attached. The cover of the column, which is fastened in place by tapped bolts, is removable, and to this is attached all the mechanism of the device. Suspended from the under side of the cover is a valve working in combination with a double-ended lever, having its fulcrum between its two ends. From the ends of the lever, two cylinders are suspended, the upper and smaller one of solid iron, and the larger, hollow, with holes in its top, so that it is filled with



Elec. World

water. When the water stands at the desired level in the boiler and column, the solid cylinder is heavier than the larger immersed cylinder, and consequently keeps the valve closed. As the water in the column lowers, the hollow cylinder filled with water overbalances the weight of the solid cylinder, when deprived of the buoyancy of the surrounding water, and opens the valve admitting steam to the alarm whistle. The solid cylinder regains its counterbalance on the admission of water to the boiler and column, closing the valve. Its



LOW WATER ALARM.

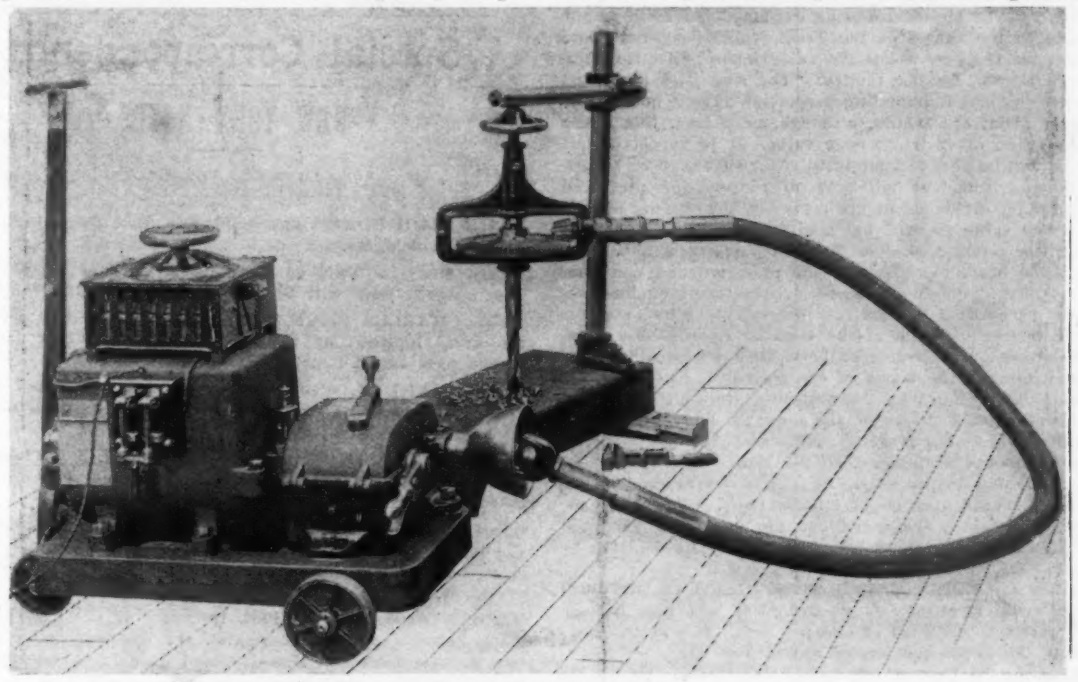
working can be tested at any time by simply opening the valve at the bottom of the column, thus lowering the water in the column and sounding the whistle.

By removing the bolts in the cover the whole of the mechanism can be lifted out for cleaning or inspection, and easily replaced without touching the boiler connections, which is important. The absence of a hollow float is another valuable feature, as experience has shown that such floats cannot be absolutely relied upon.

Portable Drill with Flexible Shaft.

In that part of the General Electric Company's exhibit in the Electricity Building devoted to motors and their different applications, there is shown a portable drill with flexible shaft. This has been brought into existence by a desire to avoid the inconvenience invariably experienced whenever it becomes necessary to drill a piece of metal too large and cumbersome for manipulation under an ordinary upright drill, and to do more rapidly work usually done with a hand-ratchet drill.

The machine consists of a motor and a gear box mounted together on a truck, a flexible shaft, a drill press and drill rest. In addition, the motor carries on its side a double-pole switch, and on top a starting rheostat. The motor is shunt wound and has two poles, with one spool on the top of the field. The armature is of the Gramme ring type, and its shaft carries a pinion serving to drive the flexible shaft through change and reduction gears, inclosed in a gear box, and which caries on the drill press and a clutch coupling connects the change gear shaft to the flexible shaft, which carries on the drill press end a clutch coupling which may be used for starting and stopping the drill. A second reduction in speed is obtained by the bevel gears driving the drill spindle. The drill press is held



NEW PORTABLE DRILL.

by a stand and arm, which may be clamped in any position.

Increase or decrease of speed is readily obtained by a movement of the side handle; and by another movement the intermediate gears are thrown in or out of mesh, when the upper lever slides the change gears into position.

This motor is rated at 1 h. p. and runs at 1,000 revolutions, reduced at the drill spindle, according to the three positions of the change gears, to 167, 87 and 12 revolutions. The machine is built for use with drills up to two inches in diameter.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Oct. 28, 1893.

ELECTRICAL STOCKS this week have not failed to participate in the advance marking all stock market transactions. The improved tone is due to the general anticipation that the early repeal by the United States Senate of the Sherman silver purchasing law must soon have such an effect on the industrial circles of the country as to quickly bring about a renewed era of well doing. As the electrical stocks represent corporations purely business in their character, it is not surprising that they should so quickly respond to the feeling that business in all directions must show and is showing a wonderful improvement by reason of the restoration of confidence and hope for the future. There is a deal in the situation to warrant these cheerful prognostications, and they are seemingly about to be realized.

WESTERN UNION, looking at the electrical stocks from a speculative standpoint, furnished the highest surprise of the week. Its rise has been rapid, and the strength with which the gain is maintained is construed as an indication that manipulation has had little to do with the spurt. To all appearances the buying of Western Union, which closed to-day at 93⅜, as compared with a closing price on Saturday last of 83½, has been genuine, and is declared to have originated from purely investment sources. The predictions now freely indulged in that the stock will touch 110 seem strangely at variance with the doleful future for the company forecast by Wall Street when the stock was around 70. The most suspicious fact of the whole occurrence is that the very people who were loudest in running the company down when it was weakening around 70 are now most instrumental in bringing about the present boom. This clique is professing to buy the stock itself, but the tales of inside purchases do not tally well with the former bear tactics of this very same crowd. In putting the price up the bulls have been much helped by the small amount of floating stock in brokers' hands. Then, too, there has been quite a short interest which the bulls managed to scare into a run. Besides this the stock must always have some recommendation to the good wishes of investors in that it always pays its dividends, and

there seems no immediate likelihood of their being reduced. It is confidently stated that earnings have picked up till now about nine per cent. is being eadned on the stock. It must be remembered, however, that some enormous losses have to be made up, and big earnings come in very handy just now to make comparisons not odious. Of course, 110 looks like a big price for a five per cent. stock, but the conditions are such that it can be readily manipulated to that figure.

GENERAL ELECTRIC'S NOVEMBER DIVIDEND, as heretofore declared in these columns, is to be passed. No official promulgation of this decision has been made, but no one any longer believes that any distribution of profits, if any have been earned, will be ordered next month. The directors state that the company is again making money, but it is better to so husband its resources and reimburse it for the big losses of last summer that similar troubles will not again be engendered. The stock's quotation shows that this decision has long been discounted. It holds very strong. Stockholders are compensated somewhat for their loss of dividends by being granted the right to subscribe, under very favorable conditions, to a series of trust securities. A circular just issued relates that "in accordance with the terms of a contract made with a syndicate which already has purchased the entire amount of shares of the street railway and illuminating properties mentioned below, the several stockholders of this company, as recorded on its books at the close of business Oct. 27, whether holding common or preferred stock, are offered at the price and on the terms below set forth, 45,000 six per cent. preferred shares and 45,000 common shares in the Trust known as Street Railway and Illuminating Properties." This syndicate is the one formed last August to underwrite the floating debt, taking in return for their subscription to the fund to liquidate the General Electric Company's pressing needs the stocks and bonds that form the assets of the "Street Railway and Illuminating Trust." The circular offering the stockholders the right to subscribe to the shares of the Trust, which acquired some $12,000,000 good treasury assets from the General Electric Company for $4,000,000, further recites: "The securities embraced in street railway and illuminating properties have a nominal or par value of about $12,000,000, although, of course, this figure is not a criterion of their intrinsic value. It is expected that the trustees will be able ultimately to realize from these securities an amount sufficient not only to redeem the preferred shares, including dividends at six per cent. per annum on the designated par value thereof, but also to distribute substantial sums upon the common shares. The trust shares will be sold in blocks, each block to consist of one preferred and one common share. Stockholders of record at the close of business Oct. 27 will be entitled to subscribe for one of such blocks for every eight shares of stock of the General Electric Company, whether common or preferred, or both, then standing in their respective names on the books of the company. The price for each block will be $100, plus the proportionate amount of dividend on the preferred shares at six per cent. per annum, payments to be made at the Trust Company receiving the subscription, in installments as follows: 30 per cent., Nov. 15; 40 per cent., Dec. 15; and 30 per cent., Jan. 15, when shares will be delivered, Payments may be anticipated Nov. 15 or Dec. 15; rights are assignable; shares cannot be issued in fractional parts, and subscriptions must be on rights in lots of eight or multiples thereof."

THE ERIE TELEPHONE AND TELEGRAPH COMPANY'S DIRECTORS will meet on Nov. 3, at Lowell, and then declare the usual quarterly dividend of one per cent. It will be made payable Nov. 20, to stockholders of record Nov. 11.

WESTINGHOUSE STOCK has appreciated a few points with the upward tendency of the market. The rise is also due to the increasing business of the company and its good prospects for the future. The announcement at the close of the week that the Niagara Cataract Construction Company had awarded their enormous dynamo contract to the Westinghouse people, will still further strengthen the stock in the financial world. The common is now offered at 25, and preferred at 45.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Boston, has declared a quarterly dividend of two per cent., payable Nov. 1.

THE NEW ENGLAND TELEPHONE AND TELEGRAPH COMPANY has declared a dividend of 75 cents per share payable Nov. 15 to stockholders of record Oct. 31.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " " com	15	15	17¼
Edison Electric Ill., New York	100	100	100¼
" " " 1sts	..	105	106
Edison Electric Ill., Brooklyn	100	95	100
" " " Boston	100	115	130
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	..	2½	5
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	5	5½
General Electric Company	100	50⅞	51
" " deb. 5's	..	80½	81
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	24½	25½
" " pfd	50	40	42
Cleveland General Electric Co	..	85	90
Western Union Telegraph	50	93⅜	93⅝

NEW INCORPORATIONS.

THE NATCHEZ LIGHT, POWER AND TRANSIT COMPANY, of Natchez, Miss., capital stock $200,000, has been formed to do a general light, power and transit business. M. Moses and A. Moses are interested.

THE TACOMA GAS AND ELECTRIC COMPANY, Tacoma, Wash., capital stock $500,000, has been formed to erect and maintain electric light and power plants, etc. W. H. Elliott, E. Rice and W. A. Rice, of Tacoma, are the organizers.

THE SUBURBAN STREET RAILWAY COMPANY, Harrisburgh, Pa., capital stock $5,000, has been formed to construct and operate an electric railway. The incorporators are W. H. Seibert, Steelton; E. K. Meyers and C. L. Brinser, Harrisburg, Pa.

THE CONNECTICUT DYNAMO AND MOTOR COMPANY, Hartford, Conn., capital stock $6,000, has been formed for the purposes indicated in its title. Roscoe W. Ney, R. E. Dunston, Hartford, and D. M. Durand, Middletown, Conn., are the incorporators.

HIGHLANDS, ORANGE COUNTY, N. Y.—The Buttermilk Falls Electric Company, $5,000, has been incorporated to furnish electric light and power. Chas. F. Roe and Geo. W. Flood, Highland Falls, and Walter C. Anthony, of Newburgh, N. Y., are interested.

THE INMAN BROTHERS CONSTRUCTION COMPANY, Jersey City, N. J., capital stock $75,000, has been formed to build electric light works, etc. The interested parties are G. B. and W. F. Inman and A. C. G. Williams-Foote, all of 136 Liberty street, New Yerk City.

THE GLADSTONE ELECTRIC LIGHTING AND POWER COMPANY, Gladstone, Mich., capital stock $50,000, has been formed for the purpose indicated in its title. The promoters are J. W. Kendrick, J. Woods, Minneapolis, Minn., and E. S. Tice, Gladstone, Mich.

THE BRYAN, MARSH COMPANY, New York City, capital stock $40,000, has been formed to manufacture and sell electric batteries, lamps, etc. C. D. Marsh, 202 West Seventy-fourth street, and T. C. Hughes, 206 West Fifty-second stret, New York City, are interested.

THE JAMAICA ELECTRIC LIGHT COMPANY, Jamaica, N. Y., has been formed to manufacture and use electricity for light, heat and power. G. R. Cullingworth, Mount Vernon; W. S. Williamson, Jamaica, and Alonzo B. Pettit, also of Jamaica, N. Y., are interested.

THE JONESVILLE ELECTRIC LIGHT AND POWER COMPANY, Jonesville, Mich., capital stock $15,000, has been formed to furnish electric light and power. G. F. Avis, Hudson; G. S. Pomeroy, E. A. Pomeroy and V. Hawkins, Jonesville, Mich., are interested parties.

THE ELECTRIC CAR VENTILATING COMPANY, Portland, Me., capital stock $500,000, has been formed to manufacture and deal in ventilating apparatus and machinery of all kinds. W. Y. Ober, Lynn, and L. B. Haskell and F. W. Homans, of Cloucester, Mass., are the promoters.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Oct. 28, 1893.

THE PARK BOARD has decided to light Central Park with incandescent lights.

THE MANHATTAN RUBBER COMPANY is the name of a new concern that will be located at 64 Cortlandt street.

MR. CHARLES C. CHAPIN received notice this week that the first shipment of the Packard non-infringing lamp, for which he is agent, had been made.

MR. HENRY W. WELLER, who has recently taken the general management of the United Columbian Electric Company, arrived in New York this week.

DR. WELLINGTON ADAMS, of the Chicago & St. Louis Electric Railroad, was in New York this week, en route to Europe, to further the interests of the company.

COL. GARDINER C. SIMS, of the Armington & Sims Engine Company, was in New York Friday. Mr. Sims was recently elected president of the bank of which he was formerly vice-president.

MR. WINDSOR T. WHITE, treasurer of the Cleveland Machine Screw Company, Cleveland, O., has been on a business trip in New York and New England during the week and will be in New York again soon.

MR. W. S. TEEPLE has severed his connection with the Teeple Electric Construction Company and is now in the West. Mr. E. A. Storey is associated with the business, now styled the Teeple Electric Company.

MR. EDWARD B. WYMAN, manager of the Central Electric Heating Company, Havemeyer Building, New York, has just returned from a two-weeks visit to the World's Fair. Mr. Wyman reports his company busy equipping 200 cars of the Atlantic avenue line, Brooklyn, N. Y., with its electric heaters.

THE M'DONOUGH CONSTRUCTION COMPANY has begun operations on the contract for the track work and overhead construction of the Bangor, Pen Argyl & Water Gap road in Pennsylvania. They are now working on the six-mile section between East Bangor and Pen Argyl, and it is expected that the road will be open to traffic by the first of the year.

MR. FRANK M. ASHLEY, inventor of the patented specialties manufactured by the Ashley Engineering Company, has begun business as a consulting engineer and contractor, and will give particular attention to designing and superintending the designing and construction of special machinery and power plants. He will continue to represent the Ashley Engineering Company as heretofore at 136 Liberty street.

MEMBERS OF THE BROOKLYN COMMON COUNCIL have met to take action in the suit brought by Noah L. Cocheu, president of the State Electric Light and Power Company, which company was refused a franchise, after offering, it is alleged, in their complaint, to do the lighting for less than contract price, as afterward awarded to another company. The matter will come up before Judge Cullen, of the Superior Court.

MR. HARRY ALEXANDER, electrical contractor, 126 Liberty street, returned from Chicago last week. His friends were at one time anxiously concerned regarding certain reports of his actions while in Chicago, as he was found wandering, apparently aimlessly, through the subways of the World's Fair grounds and caught trying to take a bath in the electric fountain. It is only fair to add that Mr. Alexander repudiates the unworthy suspicions of his friends as to his mental state, and ascribes his reported actions to professional zeal and an occasional desire to get out of sight of Chicago mud.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 28, 1893.

IT IS EXPECTED that an electric light plant will be erected at Greenfield, Mass., in the near future.

THE DIRECTORS of the Northampton Electric Light Company, of Northampton, Mass., are considering the question of building a new plant.

MR. O. H. POPE, formerly with the Mining Department of the General Electric Company, is now in the employ of the Brown Electric Company.

GEORGE E. HALL, JR., formerly general manager of the Wainwright Manufacturing Company, died on Oct. 10 of typhoid fever. This will be sad news to Mr. Hall's many friends.

THE BROWN ELECTRIC COMPANY, Boston, Mass., has finished 150 miles of road for the Meriden Street Railway the past season. It reports business in this line as very good.

THE E. P. DODGE MANUFACTURING COMPANY, of Newburyport, Mass., is to light its factories by electricity, placing a dynamo in its engine room and furnishing its own power.

MR. J. E. TALBOT, formerly with the Fort Wayne Electric Company, Fort Wayne, Ind., has taken up his residence in Boston, and will give his attention to electrical engineering.

MR. RALPH COLBURN, formerly connected with several Massachusetts electric railways, has started in business for himself at Holliston, Mass., in general electrical construction work.

THE JARVIS ENGINEERING COMPANY has put in an American Feed Water Heater, 2,300 h. p., in the Edison Electric Illuminating Company, Boston, one of the largest heaters in use.

THE W. S. HILL ELECTRIC COMPANY has recently shipped to the Philadelphia Traction Company switches in various sizes aggregating about 35,000 amperes. In this shipment was included the largest switch ever manufactured, having a capacity of 4,000 amperes. The Hill company is to be congratulated on the business which it has done during the past season. It has been not an uncommon thing to run the factory at nights in order to keep up with the demand.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
36 MONADNOCK BUILDING, CHICAGO, Oct. 27, 1893.

MR. GEORGE CUTTER, so well known among the electrical fraternity, has been chosen manager of the recently organized Westinghouse Electric Heating Company, of Chicago, with offices at 851-855 The Rookery.

THE GREAT WESTERN MANUFACTURING COMPANY state that their "Howard" incandescent lamp is having a very large sale at the present time. Its efficiency and very low price seem to commend it to all conservative purchasers. The company are also busily engaged on their Atchison (Kan.) contract, a report of which appeared in our last issue. Part of the material has already been shipped, and it is expected that within a few days active operations will be commenced. This contract is perhaps the largest that has been secured by any electrical manufacturing firm in some months, and the company feel a commendable pride in the fact that they are able to control a deal of such magnitude at this time.

W. H. M'KINLOCK, president of the Metropolitan Electric Company, Chicago, Ill., has been spending a week or two in the East. He has just returned to the World's Fair city, after securing for the Metropolitan Electric Company a number of very nice agencies, announcements regarding which will probably be made in a week or two. The Metropolitan Electric Company promises to be an important competitor in the electrical field in the West. Mr. W. H. McKinlock and his brother, Mr. Walter McKinlock, are both well known to electrical companies and other buyers of electrical supplies, and as the company will start off with a large paid-up cash capital, there seem no good reasons why it should not do a good business.

News of the Week.

ELECTRIC LIGHT AND POWER.

FAIRHAVEN, VT., is to have the electric light.

CHRISMAN, ILL.—Electric lighting is again being discussed.

BROWNSTOWN, MD., is making another attempt to get electric lights.

MINNEAPOLIS, MINN., is agitating the question of a municipal electric plant.

CORTLAND, NEB.—The citizens of Cortland are talking of putting in electric lights.

TARIFFVILLE, HARTFORD COUNTY, CONN.—There is a strong agitation here for electric lighting.

LURAY, W. VA.—Council will soon call for bids for 15 arc and five incandescent lights. L. H. Kelly is mayor.

ONTARIO, CAL., wants the electric light, and it is proposed to purchase the current from the San Antonia plant.

BELLEFONTE, PA.—A proposition has been made to light the city and it is likely that the offer will be accepted.

HUMBOLDT, TENN., will vote on the proposition for or against water-works and electric lights on the 27th of this month.

LA GRANGE, IND.—Town authorities contemplate putting in an electric lighting plant in connection with the present water-works system.

EMPORIA, KAN.—City Council has resolved to purchase an electric lighting plant. The committee on gas and electricity has the matter in hand.

JACKSONVILLE, FLA.—Of the amount of $2,000,000 in bonds, which Jacksonville recently voted to issue, a portion will be devoted to electric light plant.

ATLANTA, GA.—The movement in favor of electric lighting is growing stronger, and it is likely that definite steps toward a municipal plant will soon be taken.

MASCOUTAH, ILL.—Stockholders of the Mascoutah Electric Light Company propose to issue $5,000 in bonds to pay floating indebtedness and improve the plant.

HARRISONVILLE, MO.—The $12,000 electric light bonds have been registered, and as soon as they are sold work will be commenced on the construction of an electric light plant.

BATH, PA.—The Town Council of Bath have decided to procure the best light possible, and they will purchase an electrical equipment as soon as a site for the station can be located.

GRAND HAVEN, MICH.—The electric light plant has been sold by the Greenwich, N. Y., owners, to Andrew J. Ernlaw and Geo. W. Miller, of Grand Haven. The plant is valued at $20,000.

TOPEKA, KAN.—Members of the State Board of Public Works are in Chicago examining the electrical department of the Fair with a view to making extensive purchases for the public institutions.

OAKLAND, CAL.—The petition favoring the granting of an electric light franchise to some responsible persons has re-

ceived a number of signatures and will be presented to the trustees at the next meeting.

RICHMOND, IND.—The Richmond Electric Light Plant and the Star Gas plant have consolidated under the name of the Richmond Light, Heat and Power Company; capital $250,000. Dr. James Lower is president.

SHARON, NORFOLK COUNTY, MASS.—Dr. C. T. Chase, Dr. C. A. Leslie, S. W. Billings and W. B. Wickes, J. A. Bowman and George Kempton are the committee in the matter of getting electric lighting for Sharon.

POTSDAM, N. Y.—F. J. Herriman, A. D. Whitney and A. T. Hepburn, of Madrid, N. Y., are here looking at the local electric plant. They are the committee of Madrid, N. Y., which proposes to put in an electric lighting plant there.

WASHINGTON, D. C.—The Chris Heurich Brewing Company has had plans prepared by C. F. Terney for a brewery to be located on the square south of E street between Twenty-fifth and Twenty-sixth streets and an electric lighting plant will be put in.

DALLAS, TEX.—One hundred thousand dollars in bonds will be issued for the construction of a water-works and electric lighting system, and the mayor and light committee were authorized to call for bids for the construction of an electric lighting plant.

BATAVIA, N. Y.—It will be remembered that the village trustees were authorized to issue bonds to amount of $23,000 to pay for an electric lighting plant, but no steps have yet been taken. A petition is now being circulated asking the trustees to take action.

RUSSELLVILLE, KY.—The City Council has granted a franchise to W. F. Browder, A. C. Hodgen, D. Evans, S. V. Leedom, P. C. Andrews and others to erect an electric light plant and has contracted to light the city. The plant will be built immediately and is estimated to cost $10,000.

MIDDLESBORO, MASS.—Messrs. Hawley, Pettibone and Henry Legate have been engaged to present the side of the people in favor of municipal electric lighting at a meeting to be held on the 28th inst. It is proposed to purchase the present plant of the Middlesboro Gas and Electric Company, and improve the same. It is offered for $63,000.

WASHINGTON, D. C.—The commissioners have made the first move in the matter of a municipal plant by voting unanimously to ask Congress for an appropriation of $300,000 to authorize the purchase or condemnation of the present underground electrical conduit system and for the extension of the service.

PALMYRA, N. Y.—Carlton C. M. Hunt and B. H. Davis were granted a franchise over a year ago to put up an electric light plant for street and general lighting purposes, and they filed a bond of $2,000, but it is evident that they do not intend to fill their contract and residents have given up hope. The complaints are many of the poor light furnished by the gas company, and prominent residents are talking of getting up an electric light company. Nothing definite has yet been done.

FITCHBURG, MASS.—The Wanoosnoc Power Company has been organized with a capital of $20,000, to use the water power at the Atherton water privilege, and convert same into electricity for manufacturing purposes. Daniel Simonds is president; G. M. Holman, A. T. Clifford, Carl Hibbell and George W. Holman are directors; G. M. Holman is clerk, and A. T. Gifford will supervise the work of erecting. Mr. Gifford will appear before the Merchants' Association in the near future and address them on the subject of the city furnishing its own lights by locating an electrical power station at Meeting House Pond.

THE ELECTRIC RAILWAY.

LYNCHBURG, VA.—The Rivermont Street Railway Company will extend its lines. J. P. Pettyjohn will give details.

CLINTON, MASS.—A. J. Witherell, treasurer of the Clinton Street Railway, states that the road will be built to Lancaster soon.

TYRONE, PA.—John Lemon, of Tyrone, has been awarded the contract for grading 10 miles of the Carlisle Electric Street Railway.

CULPEPER, VA.—Residents are interested in the proposed electric railway between there and Sperryville in Rappahannock County.

WOONSOCKET, R. I.—Fifty residents of South Main street and Union Village have petitioned the Woonsocket Street Railway to extend its line to Union Village.

TOLEDO, O.—The company organized to build the electric road from Detroit has elected the following officers: J. H. Ainsworth, president, and L. K. Parks, of Toledo, secretary.

PATERSON, N. J.—Steele & Hopper, of Paterson, N. J., have the contract for the proposed new power house and carhouse to be built on the plank road near the Erie short cut by the Morris Railroad system.

ORANGE, N. Y.—The Orange correspondent of the New York "Evening Post" is authority for the statement that surveys are being made for an electric road between Paterson and New Brunswick by way of Orange and Montclair.

CHESTER, PA.—Work on the proposed Chester & Wilmington electric road will be commenced in the spring, and an independent power plant will be built at Marcus Hook, Pa. Recorder Kerlin, of Chester, Pa., is heavily interested.

BRADFORD, PA.—The ordinance to grant a franchise to the Bradford & Kendall Street Railway Company to construct and operate an electric street railway here has again come up before City Councils, but no definite action was taken.

SCRANTON, PA.—The Scranton Traction Company expects to operate a line to Taylor by Dec. 1. P. S. Page has the contract for the road building. The remainder of the road between Scranton and Pittston will not be built until spring.

SHARPSBURG, PA.—A scheme is afoot to build an electric railway from Etna to Tarentum. The Allegheny & Kiskiminotas Electric Street Railway has applied for a charter and will apply to Sharpsburg Council for right of way at their next meeting.

PLAINFIELD, N. J.—Messrs. Runyon & Moffett state that they have consents from two-thirds of the property owners along the road to Dunellen, and that they will petition City Council at next meeting for leave to commence work at once laying tracks.

NEWTON, MASS.—The Newton & Cochituate Street Railway Company has been formed in Newton to take up the franchise abandoned by the Newton & Wellesley Street Railway Company, and it is proposed to construct the line and operate same by electricity.

WHITE PLAINS, N. Y.—The New York, White Plains & Mamaroneck Railway Company will ask the board of trustees of White Plains for permission to build a double or single operative track along Mamaroneck road and Railroad avenue to the village of White Plains.

ELIZABETH, N. J.—Councilman Campbell has introduced a resolution that the street committee and president of the Council look up the matter of the trolley system in anticipation of a petition from the New Jersey Traction Company for a franchise to run their cars through the city.

MARTINSBURG, MD.—The City Council has declared forfeited the franchise granted to the Martinsburg Railway Company, but John B. Wilson, president of the company, announces his intention of suspending operations until the spring election and then appealing to the people of the city for decision by ballot.

CHICAGO, ILL.—The Lake Shore, River View & Elgin Railroad proposes to build a railway from a point on the shore of Lake Michigan between Rogers Park and Evanston to River View on the Wisconsin Central, and thence to Elgin, Ill. The principal office will be in Chicago. D. W. Wood, of Park Ridge, Ill., is president and Thos. H. Colman, of Rogers Park, Ill., is treasurer.

BOONSBORO, MD.—Officials of the proposed electric road between here and Keedysville state that the road will be in running order by Jan. 1 next. The company was incorporated under the name of the South Mountain Railway and Electric Light Company. Work will at once be commenced. Contracts for rails and ties have been awarded and the franchises have been perfected.

DETROIT, MICH.—A new company, formed to build a road between Detroit and Toledo, O., has elected the following officers: President, J. H. Ainsworth, Toledo; vice-president, L. K. Parks, Toledo; secretary, J. H. Warner, New York; treasurer, J. Ellery Eaton, Toledo; general manager, H. H. Johnson, New York. The company was incorporated under the laws of the State of Michigan, and the documents are on file in Lansing. The work of securing the franchise and right of way is completed. The object will be to run cars about every hour, and to carry merchandise and express, as well as passengers. Overtures have already been made by the express companies. The line will be 56 miles in length, and will be laid with steel rails. The coaches will be vestibuled and furnished in the latest and most approved style. J. Ellery Eaton says the road will be the direct outlet for travel for nearly 500,000 people, and, if properly conducted, there is no reason why it should not be a paying investment right from the start. It will touch Monroe, Vienna, La Salle, Flat Rock, and other intermediate points, and will follow the line of the old government mail road. The project is looked upon with favor by the people generally all along the proposed line. It is designed to have the road in full operation in early spring, and possibly as early as Feb. 1.

PERSONAL NOTES.

MR. F. H. SHEPARD, who has been in charge of the electrical equipment of the Milwaukee Street Railway, has resigned his position in order to take a course at the Massachusetts Institute of Technology.

DR. L. K. BOEHM has been elected president of the Technical Society of New York. This society is the leading club in the National Association of German-American Technologists and has about 250 members. "Der Techniker" is the official periodical of the association, and is the only technical perfodical printed in the German language in the Unitd States.

MISCELLANEOUS NOTES.

AN ELECTRIC POLE FOREST.—Norfolk, Va., has on some streets six separate pole lines.

POLE TAX.—A number of towns have taken advantage of the recent decision of the U. S. Supreme Court and imposed a pole tax, in some cases as high as $1 per pole.

THE NEW YORK ELECTRICAL SOCIETY will hold its 1,253d meeting at Columbia College, Forty-ninth street and Madison avenue, on Tuesday, Oct. 31, at 8 p. m., when Mr. D. McFarlan Moore will deliver a lecture on "Electricity in Advertising."

STATE EXECUTIONEER DAVIS is reported as about to apply for a patent for an electric death dealing apparatus which he thinks will allow of the carrying out of the electrocution law without any trouble whatever in the future.

SEVERAL DIRECTORS of the Madison Square Bank, of New York, which failed last summer, were arrested, Oct. 23, among them Mr. R. T. McDonald, of the Fort Wayne Electric Company. Mr. McDonald is charged with having indorsed on a note the words "Not negotiable only in accordance with contract under which notes were made." The contract was that the securities pledged to secure the note were not to be sold below 90, and it is claimed that they were not worth 90, and that therefore, under the agreement, the bank would be unable to realize upon them.

A ROTARY SNOW PLOW.—The Light and Traction Company of Dubuque, Ia., are building a large rotary snow plow at their yards, near the power house, which promises to sweep everything before it. The car will be used exclusively for carrying sand, salt and tools for construction and repairs along the various lines. The framework is very heavy and the cylinder of long steel brushes will revolve ahead of the snow plow. The plow will force the snow off to the right, so that making the round trip the track can be easily cleared. The car will be supplied with four large motors which will furnish ample power to propel the car through a heavy snow.

ELECTRICAL CANAL BOATS.—The Alabama & Georgia Canal and Transportation Company has been formed with a capital stock of $5,000,000, to build 150 miles of canal between Decatur, Birmingham and other Alabama towns, and to extend to Columbus, Savannah and other towns in Georgia. The propelling power will be a stern screw which will be operated by electricity. In order to do this the trolley system will be used along the portions where the canal is used. This system is very similar to the street car system. The canals will be the usual width, which will admit of two wires being strung, making a kind of double track system.

A FEAT IN TELEGRAPHY.—The Glasgow "Times" says: "The time occupied by our cablegram from New York to Glasgow was 30 seconds, three minutes only after 'Vigilant' had crossed the line. Subsequent telegrams were transmitted with equal dispatch. For this extraordinary expedition we have to express our thanks to the Commercial Cable Company, whose admirable arrangements for immediate transmission of the special messages from our correspondent enabled us to be first in the field. The Commercial company have thus, in view of the adverse and trying weather conditions on the other side of the Atlantic, performed a feat well nigh unexampled in the history of the telegraph."

IN THE NEW TARIFF BILL which is now in preparation the following articles are contemplated for the free list, although no definite conclusions have yet been reached: Scrap iron and steel, zinc and spelter, lead, iron ores, steel ingots, cogged ingots, blooms, slabs, die blocks or blanks, billets and bars and tapered or beveled bars, shafting, wrist or crank pins, connecting rods and piston rods, pressed, sheared or stamped shapes, hammer molds or swaged steel, alloys used as substitutes for steel tools, dry sand, loam, iron, molded steel casings, and steel in all forms not specially provided for, metal compositions (aluminium, argentine, albata, German silver, metallic mineral substances, nickel and nickel oxide, quicksilver, mica, talc), wood, copper, brass, resins, skins other than fur skins.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS' headquarters at the World's Fair contained a most complete collection of autograph portraits of men prominently identified with the electrical profession. This interesting collection is the property of Mr. Wm. J. Hammer, Havemeyer Building, 26 Cortlandt street, New York City, chairman of the Ways and Means Committee in charge of Institute matters at the Exposition. As a number of colleges and educational societies have expressed a desire to secure copies of these photographs, of which there are eight sets, numbering in all 200 photographs, Mr. Hammer has arranged to dispose of a limited number of copies of these sets, which are about one-third the size of the originals, provided that the use to which they are put will not be objectionable to those who have placed their autographs in the collection. The dimensions of each of the eight sets is about 18 by 22 inches. The list includes the names of almost every well known electrician and scientist in this country and Europe.

Trade and Industrial Notes.

A. V. SCHOONMAKER, 158 William street, is now furnishing his solid sheet india-rubber mica, cut ready for commutator segments, rheostats, etc., and is also prepared to cut to any pattern or shape that may be wanted.

THE BOSTON ELECTRIC WIRE COMPANY, Allston, Mass., which makes a specialty of magnet wire of the best quality uniformly drawn to an exact diameter, furnishes to the order of manufacturers of electrical machinery magnet wire of the exact outside diameter required, to a thousandth of an inch.

W. A. FENN, general manager of the American Electrical Supply Company, of Buffalo, has secured for his company the contract for the electric light installation in the residence of the Hon. J. Sloat Fassett, at Elmira, N. Y. It is to be a complete interior conduit system, brass armored conduit being used throughout.

SHERBURNE MORSE, Arkansas City, Kan., has completed the work of putting in the wire and fixtures for electric lights and return call communication system at the Kerfoot Hotel, El Reno, O. T. This is the largest building of the kind in the Territory. Mr. Morse is also putting in a private telephone and telegraph line seven miles long.

MR. OTTO M. RAU, electrical engineer of the Edison power house, Milwaukee, compiled a handsome convention souvenir for presentation to those attending the recent meeting of the American Street Railway Convention, in which are given a number of views of the details of the plant, and a concise and technical description of the same.

THE AMERICAN [illegible] GLASS MANUFACTURING COMPANY, Tacony, Philadelphia, has issued two pamphlets, one containing testimonials relating to, and the other a description of, their wire glass, which consists of sheet glass having embedded in its centre a sheet of wire netting to strengthen the glass and prevent accidents from broken skylights, etc.

H. WARD LEONARD & CO., Electrical Exchange Building, New York, send us a neat blotter which they have gotten up to present to their patrons. One side is of enameled cardboard, on which is printed a long list of installations made, consisting, among others, of no less than 53 office buildings, 31 central stations, 31 apartment houses, 9 electric railways and 9 theatres.

QUEEN & CO., Philadelphia, have issued a handsomely bound and printed catalogue devoted to electrical testing instruments, which contains an illustrated and descriptive list of instruments of their own manufacture, as well as of those made in Europe, of which they have the agency. The catalogue is a model of its kind, and the appreciation of their instruments is shown by a collection of letters signed by the names of authorities not usually met with in connection with commercial testimonials.

THE H. W. JOHNS MANUFACTURING COMPANY, 87 Maiden Lane, New York, has received a letter from Mr. T. F. White in relation to a recent accident in Jersey City from a child taking hold of a live trolley wire. Mr. White, who happened to be passing in a trolley car, cut the wire, and writes that without the plyers used, which he always carries with him, nothing could have saved the child's life. The plyers were protected with Johns molded mica handle covers, which enabled the wire to be cut without danger.

SAUTTER, HARLE ET CIE., 26 Avenue de Suffern, Paris, France, one of the few extensive foreign exhibitors at Chicago, has issued a handsomely printed pamphlet containing technical notes on their exhibit at the World's Fair, a copy of which has been kindly forwarded to us by M. Georges Pellissier, their World's Fair representative. The pamphlet, which is in French and English in parallel columns, is handsomely printed and is altogether a model of what should be supplied to visitors at such exhibitions to enable them to obtain an intelligent idea of the exhibits.

THE RELIANCE GAUGE COMPANY, of Cleveland, O., informs us that it carried off all the honors for its class at the World's Fair, receiving the highest medal awards on both safety water columns and floats. As competition was active, particularly on water columns, the fact that competitive devices did not receive even so much as honorable mention speaks well for the Reliance safety water columns, particularly the awards were based on on the practical operation of the various devices on the boilers in the power plant in Machinery Hall.

MORSE, WILLIAMS & CO., 1105 Frankford street, Philadelphia, Pa., were awarded a medal at the World's Columbian Exposition for their elevator, which was in service to convey people to the gallery of the Transportation Building. This machine was designed especially to obtain simplicity of construc-

tion, accessibility of parts for repairs, and smoothness in running, the latter important feature being attained by the use of the improved Hindley worm gearing, the manufacture of which this company has made a specialty for years. This elevator has worked with great success throughout the Exposition.

THE PHILADELPHIA TRACTION COMPANY have placed the order for their new power house with the Berlin Iron Bridge Company, of East Berlin, Conn. The side walls will be of brick and the roof will be of iron. The building is 100 feet in width and 168 feet in length, divided into boiler room, engine room and dynamo room. An order has also been received from Thomas Sully, architect, of New Orleans, La., for an iron roof for a sugar house at Tampa, Fla. The building will be 60 feet in width and 125 feet in length, the trusses being entirely of iron covered with corrugated iron.

THE NATIONAL WATER TUBE BOILER COMPANY'S plant at the World's Columbian Exposition has shown an average duty of 41 per cent. above the contract, which was based on 30 pounds evaporation per hour. The highest average excess reached by any of the other plants is 19 per cent., while several are below the guaranteed duty, and others only 5 per cent. above. The tests were all made by the Exposition authorities. The "National" boilers are nominally rated at 1,500 h. p., but as rated in the tables of the company are only 1,330 h. p. The equivalent evaporation for several consecutive weeks, as shown by the official tests, has been that of over 2,000 h. p., with not the least appearance of forcing. The steam continually furnished is exceptionally dry.

THE GREAT WESTERN MANUFACTURING COMPANY report large sales of "Clark" wire, of which they are general Western agents. This wire has been on the market for many years, and its reputation is well established. The Western company report that they find many customers who prefer this brand of wire to any other on account of its many excellent qualities. They carry a large stock of it both at their Chicago and St. Louis offices, and are in a position to fill all orders promptly. The other brand of wire handled by this enterprising house is known as their "H. G." brand of weatherproof magnet wire, which enjoys an enormous weekly output. In order to enable them to fill all requisitions promptly, the Great Western Company always carry in stock no less than 200,000 pounds of this wire.

THE ELECTRIC APPLIANCE COMPANY is exhibiting in its Chicago salesroom a 300-c. p. Packard lamp, which is one of the latest specialties of the Packard company. During the comparative quiet of the past summer this company has devoted its attention to the development of some new ideas in the incandescent lamp line. Its first venture was a successful commercial 6-c. p. lamp, to burn singly on circuits of regular voltage. The last improvement has been in the production of a lamp of exceedingly high candle power and it is now supplying lamps of 200, 300 and 500 c. p. to burn singly on incandescent circuits of any voltage and having a commercial efficiency of 2½ watts. The 300-c. p. lamp that the Electric Appliance Company is burning in its store is attracting considerable attention. It is more than displacing one arc light and gives much better results at a less cost for current than the arc light which formerly occupied its position. The lamp is called the Packard "Mogul."

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N.Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED OCT. 24, 1893.

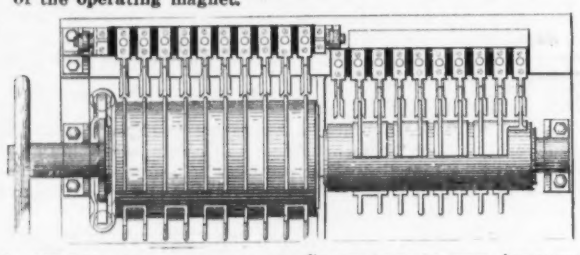
(IN CHARGE OF W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.)

507,125. ELECTRIC SIGNAL FOR RAILWAYS; A. B. Herrick, Bayonne, N. J. Application filed Feb. 11, 1891. In an electric railway signal, the combination with a railway track divided into blocks or sections by signaling points at intervals, of a line wire along the track, and signal setting instruments at the signaling points in connection with the line wire and comprising each an actuating electromagnet, and a circuit changing device constructed to connect the line wire in one position with the station in the rear and in another position with the ground.

507,139. STORAGE BATTERY; C. W. Kennedy, Philadelphia, Pa. Application filed Oct. 19, 1892. In a storage battery, an "active section" consisting of a frame of non-conducting acid proof material, and a plate of metallic lead confined within said frame and coated on one side, to the thickness of the frame, with red lead, and on the opposite side, also to the thickness of the frame on that side, with a layer of litharge.

507,144. APPARATUS FOR CONTROLLING THE APPLICATION OF ELECTRICAL CURRENTS; R. Lundell, Brooklyn, N. Y. Application filed April 4, 1893. A circuit interrupting device or switch, consisting of one or more series of bridging contacts carried by a rotary drum and lying in the path of corresponding pairs of yielding contact springs carried by a rocking bar provided with means for causing a sudden rupture of the circuits between the bridging contacts and the springs as the drum operated. (See illustration.)

507,147. DEVICE FOR SELECTING AND OPERATING MECHANICAL APPARATUS; R. Mackie, Cincinnati, O. Application filed July 14, 1891. In a selecting system, a receiving instrument adapted to respond to a fixed combination of electrical impulses in circuit with an impulse transmitting instrument in combination with locking means for locking the receiving instrument to prepare it for future electrical impulses, means for shunting the current to an operating magnet, mechanical devices and means for operating the same by impulses of the transmitting instrument through the coils of the operating magnet.



No. 507,144—APPARATUS FOR CONTROLLING THE APPLICATION OF ELECTRICAL CURRENTS.

507,148. APPARATUS FOR SELECTING AND OPERATING MECHANICAL DEVICES; R. Mackie, Cincinnati, O. Application filed July 14, 1891. The combination with an electrical impulse transmitting instrument, of a mechanical apparatus advanced into position by an impulse or impulses from said transmitter, a selecting or preparing instrument responding to a predetermined arrangement of electrical impulses and thereby connecting the transmitting apparatus operatively with the mechanical apparatus.

507,150. CUT-OUT; L. W. Miller, Rochester, N. Y. Application filed July 29, 1893. The combination, in a cut-out, for an electric signal box, of ways, a sliding block made of insulating material and provided with plates, two contact springs of different lengths arranged at one end of the movement of the block, one of these springs having portions of different lengths, and a third contact spring located at the opposite end of said movement.

507,170. ELECTRIC ALARM SIGNAL FOR RAILWAY TRAINS; J. M. Rupel, Kansas City, Kan. Application filed April 26, 1892. In an electric train signal, a line conductor comprising a number of sections, having branched or bifurcated ends, and a number of couplings interposed between the sections, having each a pair of eyes or rings pivoted thereto, to which the branched ends of the sections are secured.

507,194. ARMATURE FOR DYNAMOS; J. J. Wood, Fort Wayne, Ind. Application filed June 3, 1893. A multipolar armature core in the form of a laminated ring, having polar projections for receiving the coils, constructed with ventilating channels or spaces extending outwardly along the polar projections for the circulation of air between these projections and the coils. (See illustration.)

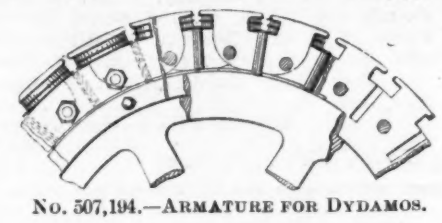
507,205. ELECTRIC SELECTING DEVICE; S. S. Bogart, New York, N. Y. Application filed Nov. 24, 1891. In an electric selecting device, a movable wheel, bar or sector, provided with a mechanical representation of a fixed combination of electrical impulses, consisting of a series of members, each member representing one or more of the electrical impulses, and separated from the adjoining member of the combination; in combination with an electromagnet and its armature lever acting directly on the wheel and responding to the transmitted impulses to positively impel the wheel or sector to work out the combination, and means for transmitting the combination impulses.

507,206. ELECTRIC SELECTING DEVICE; S. S. Bogart, New York, N. Y. Application filed Dec. 9, 1891. In an improvement in electric selecting devices, a wheel or sector provided with a mechanical representation of a fixed combination of electrical impulses, an electromagnet provided with an armature lever and its pawl to impel the wheel and work out the combination in response to the electrical impulses, in combination with a checking mechanism to hold the wheel or sector at each forward movement and prevent it from returning backward, and mechanical devices operated by the armature lever and its pawl to release the checking mechanism when a false impulse is transmitted.

507,217. ELECTRIC HEATER; C. L. Coombs, Washington, D. C. Application filed Feb. 11, 1893. In an electric heater the combination with the resistances, consisting of insulated carbons, located between suitable heads, and connected in series, as shown, and a switch lever pivoted centrally between the exposed ends of the resistances and connections, whereby one or more of said resistances may be brought into an electric circuit.

507,247. TROLLEY WIRE CLEANER; C. H. Thompson, Detroit, Mich. Application filed Dec. 10, 1892. The combination of a car, the wire, the trolley arm, spring arm, the motor, and means whereby the motor is adapted to operate the spring arm.

507,257. INSULATED WIRE; H. H. Brown, Montreal, Can. Application filed Oct. 12, 1892. In the insulation of wire for electrical purposes the combination of an inner waterproofing coat of plastic material; two superimposed braid coverings the innermost one of which is saturated when in place with a solution of silicate of soda, and an outer coating of size.



No. 507,194.—ARMATURE FOR DYDAMOS.

507,269. ELECTRIC DOOR OPERATING APPARATUS; O. H. Hicks and R. F. Troy, Chicago, Ill. Application filed May 15, 1893. In combination with a door, a normally rotating motor, an electrically connecting medium between the motor and door, normally out of engagement with the motor, and primary actuating means, connected with such connecting medium and operating, by pressure upon it, to control the engagement of the connecting medium with the motor to operate the door.

507,297. ARMATURE COIL FOR DYNAMOS; G. Wilkes, Detroit, Mich. Application filed June 20, 1893. In a wound coil for slotted armatures, two straight rectangular bars adapted to be laid in the armature slots and one shorter than the other, two short rectangular arms arranged at the respective ends of the shorter of said bars and at right angles thereto, and long curved connecting webs between the said short arms and the longer straight bar, offset from the short arms and having their faces or widest portion in a direction parallel to the axis. (See illustration.)

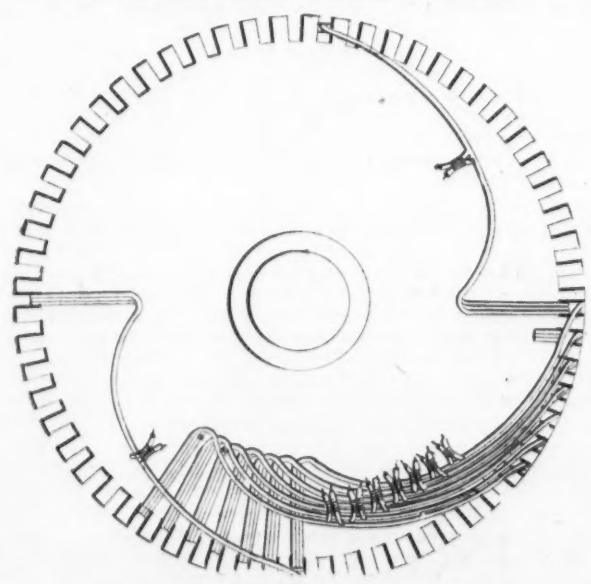
507,298. APPLICATION OF ELECTRICITY TO PIANOS OR OTHER KEYED INSTRUMENTS FOR HYGIENIC PURPOSES; W. Willeringhaus, London, Eng. Application filed May 29, 1893. A pianoforte, organ or like keyed instrument or apparatus the keys of which are provided with electric conductors and joined up with an electric battery or other suitable sources of electricity, and whereby the act of playing or operating the instrument will complete the circuit so as to communicate the current of electricity to the performer or operator.

507,299. TROLLEY WIRE INSULATOR; M. S. Williams, Syracuse, N. Y. Application filed July 5, 1892. In an insulator, the combination with a tubular body portion having a terminal hood, of a cylindrical block of insulating material entering the tubular body and a set screw for adjustably securing the block therein, a socket piece detachably fixed to the lower extremity of the block and a wire clamping device swiveled in the socket piece.

507,322. ELECTRIC FIRE AND STABLE ALARM AND HORSE RELEASER; A. R. Holmes, New York, N. Y. Application filed Feb. 4, 1893. The combination of a battery, a thermostat, a halter fastener, a magnet to release the fastener, a conductor from one side of the battery to one side of the thermostat, and a conductor from the other side of the battery to the other side of the thermostat, and connected to the magnet.

507,339. CLOSED CONDUIT ELECTRIC RAILWAY; R. Weir, Montclair, N. J. Application filed May 10, 1893. In a railway conduit having a slot, a slot closing device consisting of a closing head or strip support from below by a flexible flap, said flap being fixed at its lower edge and free at its upper edge in combination with a cam carried by the vehicle and adapted to distort or curve it to one side to open the slot. (See illustration.)

507,343. HANGER BOARD FOR ELECTRIC ARC LAMPS; J. J. Wood, Fort Wayne, Ind. Application filed June 7, 1893. A hanger board consisting of a base plate adapted for attachment to a ceiling, formed with opposite seats and insulated lamp suspenders and binding posts fixed to the seats.



No. 507,207.—ARMATURE COIL FOR DYNAMOS.

507,344. COMMUTATOR BRUSH HOLDER; J. J. Wood, Fort Wayne, Ind. Application filed June 27, 1893. In combination with a supporting stud, a commutator brush holder consisting of a socket piece having a pivotal bearing on said stud, and a boss having a screw for fixing it to the stud, and an adjusting screw working in the boss and acting against the stud socket piece to rock it on the stud and adjust the brush against the commutator.

507,345. RESISTANCE COIL; J. J. Wood, Fort Wayne, Ind. Application filed June 30, 1893. A resistance coil consisting of two parallel metal tapes, one of them wound with an open spiral of insulating material and the two coiled together into a flat coil.

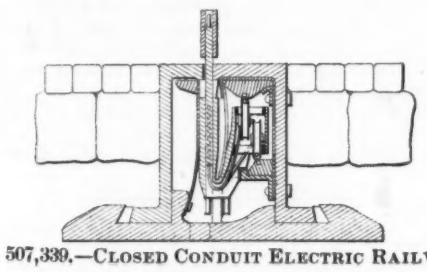
507,364. HANGER FOR ELECTRIC LAMPS; G. P. Hiler, Grand Haven, Mich. Application filed Dec. 3, 1892. In an electric arc lamp hanger, the combination of suspended conductors, contact wheels adapted to travel thereon, the axle made of non-conducting material connecting the wheels, the conducting journals on which wheels are mounted extending into the axle, the lamp in circuit with the journals.

507,374. ELECTRODE; F. M. Lyte, London, Eng. Application filed June 1, 1893. The combination with a hollow carbon electrode closed at the bottom, of a core of metal or alloy, which is fusible at or below the temperature at which the electrolytic decomposition of a fused metallic salt is to be performed.

507,391. SYSTEM OF ELECTRCAL DISTRIBUTION; W. Stanley, Jr., and J. F. Kelly, Pittsfield, Mass. Application filed March 8, 1892. In a system of electrical distribution, the combination of a constant current alternating generator, a circuit and primary coils in series therein, local or working circuits containing translating devices in multiple arc, secondary coils for supplying current thereto, and polarization coils in series with the secondary coils adapted to neutralize the electromotive force of self-induction therein.

507,396. ELECTRIC LOCOMOTIVE; J. T. Wilson, Tyrone, Pa. Application filed April 7, 1893. In an electric motor truck, the combination with the car axles provided with cranks, of one or more pairs of electric motors arranged to reciprocate simultaneously in opposite directions and connected with the cranks of the axles.

507,403. CONNECTOR; C. Bell, Stroudsburg, Pa. Application filed Jan. 28, 1893. A connector for electrical conductors, formed of two similar longitudinally gsooved parts, and a clamping screw passing through one part into a threaded hole in the other part, the groove in one part being deeper than the groove in the other part.



No. 507,339.—CLOSED CONDUIT ELECTRIC RAILWAY.

507,419. ELECTRIC HEATING AND WELDING APPARATUS; C. L. Coffin, Detroit, Mich. Application filed Jan. 26, 1893. In an apparatus for electrically welding or working metal by means of a voltaic current arc sprung between the article to be welded or worked and an extraneous conductor, a magnetic holder for the extraneous conductor, and a magnetic support for the material.

507,424. DISTRIBUTING FRAME FOR ELECTRIC WIRES; W. S. Ford, Chelsea, and B. A. Lenfest, Wakefield, Mass. Application filed March 31, 1892. A distributing frame having on one side vertical ledges or supports, and on the opposite side horizontal ledges or supports, and metallic terminals extending along the ledges.

507,449. RECIPROCATING ELECTRIC MOTOR; H. Pieper, Liege, Belgium. Application filed Sept. 23, 1891. The combination with an electromagnet having two or more pole pieces and an iron armature so arranged as to continuously close the magnetic circuit or circuits through small spaces and to permit a relative motion between it and the armature, of two or more coils fixed upon the armature and so arranged that there shall be one coil in each of the spaces, the coils being successively wound in opposite directions and each of them being longer than the respective space.

507,458. ADJUSTABLE INDUCTION COIL; E. M. Senseney, St. Louis, Mo. Application filed Dec. 5, 1892. An electric current controller comprising an electrical inductorium, having a fixed primary coil and a separately wound insulated rotatable secondary coil adapted to be moved into and out of the field of force of the primary to vary and regulate the electromotive force of the induced current flowing in the derived circuit through the secondary.

507,463. SECONDARY BATTERY; C. A. Smythe, Momence, Ia. Application filed March 3, 1893. The method of producing an electrode for secondary batteries which consists of oxidizing perforated leaden balls or blocks in a bath of nitric acid and water; producing a plastic material and perforated blocks or balls and subjecting the same to pressure, to fill the perforations in said balls or blocks and unite the whole into a solid homogeneous body.

507,493. CONDUIT FOR ELECTRIC RAILWAYS; G. F. Green, Kalamazoo, Mich. Application filed April 28, 1892. The combination with a railway track, of a conduit for electric conductors consisting of a lower semi-circular section having projecting side flanges at or near the upper edges thereof, and two upper sections each having projecting side flanges at the lower edges thereof, adapted to rest on and be connected to the flanges of the lower section, crossties for supporting the rails of said track, and longitudinal stringers on the crossties, the side flanges being adapted to rest on the stringers and thus support the conduit, the conductor being supported in the lower semi-circular section.

507,518. ELECTRIC APPARATUS FOR CONTROLLING SIGNALS; M. B. Leonard, Richmond, Va. Application filed March 14, 1892. A selecting or preparing instrument adapted to respond to a predetermined arrangement of electrical impulses, and a transmitting device for transmitting said impulses, in combination with a lock signal and means operated by the selecting instrument to unlock the signal and means for preventing the operation of these devices until the operator's signal is placed in a normal position.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1876—can be had for 25 cents. Give date and number of patent desired, and address The W. J. Johnston Co., Ltd., Times Building, N. Y.